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NEW DYNAMO-ELECTRIC MACHINES.

Electricians and the public generally are just at the present moment greatly interested to learn more of the new dynamo-electric machine about to be introduced, and which is stated to be the joint production of Sir William Thomson and Mr. Ferranti. More correctly speaking, we believe that both inventors worked out their ideas independently, but that in the one patent there is something which is wanting in the other; therefore, to be more completely successful, the patentees have combined their efforts with the result of effecting—so it is said—a revolution in such machines. We do not suppose that the promoters of the new invention expect to obtain a greater electrical efficiency from the machine, in proportion to the power taken to drive it, than can now be obtained from the best machines of the present day; but even supposing there are others as good electrically, a great step in advance has been made if the cost of construction, and therefore the selling price, is materially reduced, and this we understand is actually the case. In our "Notes" columns last week it was stated upon the authority of those directly interested in the Ferranti-Thomson invention that it produced four times (nearly) as much work in the external circuit for incandescent electric lamps as the machines of Brush, using in each case the same horse-power. If this is a fact, then the latter machine must have a very low electrical efficiency externally, probably not exceeding 20 per cent. of the engine-power expended. We cannot however quite credit the above comparison of the two systems, especially if the Brush machine were constructed for the special purpose of employment with incandescent lamps.

Mr. Hammond's statement to the effect that the Ferranti-Thomson machine is five times superior to others was, we find, purely of a commercial character. He argues that if a dynamo-electric machine costing £250 and sold for, say, £750 is compared with another, equally good electrically, costing £50, and which can be sold for £150, the one is five times as efficient as the other, or what comes to the same thing, one might purchase for the price of the £750 dynamo-electric machine, five smaller machines doing individually the same amount of work as the larger one, and, therefore, obtain for the same outlay five times the amount of work. The matter, however, ends at the first cost, as the expense of motive-power would be five times as great for the multiplication of work done. Mr. Hammond, in his remarks, does not take into account that one machine is of the alternating current type, and that the other produces a continuous current, neither does he mention that an exciter would be employed to magnetise the field magnets of the new machine. One point gained by Messrs. Ferranti and Thomson in the revolving armature proposed by them is its low internal resistance. In fact, we should have here a machine which practically eliminates an element which in nearly all other arrangements reduces the percentage of what should be useful work to a considerable degree. Again, as there is no iron in the armature, rapid reversals of magnetism, which in certain alternating current machines produce considerable heating, is thereby avoided. It remains to be seen, however, to what degree of perfection the cheap production of electricity has arrived by means of this invention, but it appears certain that a great step in advance is about to be attained, and that by its means the ultimate success of electric lighting will be much enhanced.

ELECTRICAL INTERCOMMUNICATION ON RAILWAY TRAINS IN MOTION.

By W. H. FLOYD, M.S.T.E.,
Superintendent of Telegraphs, Great Indian Peninsula Railway.

Although twenty-seven years have passed since the first attempt was made in England to establish an electrical intercommunication on railway trains in motion, and several plans have been brought forward with that object from time to time, it can scarcely be said that any electrical system has been so thoroughly tried under varied conditions, as to give complete assurance that it may be relied upon to satisfactorily afford communication between passengers, guards, and engine drivers on railway trains in India. The first practical system of electrical intercommunication brought forward in England was introduced by Mr. W. H. Preece in 1864, but, although it was successfully tried on the London and South-Western and other lines of railway, it was prevented from coming into extended use by the preference of railway authorities for the mechanical arrangement known as the "cord" system, that was conditionally sanctioned by the Board of Trade in 1867.

In 1865 the South-Eastern Railway Company adopted an electrical system of intercommunication, introduced by the Company's Telegraph Engineer, Mr. C. V. Walker, and that system has, it is believed, worked satisfactorily ever since under Mr. Walker's supervision.

In the same year Messrs. Varley and Martin patented an electrical system of intercommunication, and the royal train on the London and North-Western Railway line was fitted with it.

A train running daily between London and Wolverhampton was also fitted with this system, which is said to have worked regularly and well for nearly two years. At the end of that time the train was called in for repairs, and its successor was fitted upon the "cord" system.

In 1872 an electrical system was introduced by Colonel Binney on the Great Eastern Railway.

Between 1872 and 1878 no fresh plans were brought forward, and, in the latter year, it was said that only two systems of the four mentioned remained in practical use—viz., Walker's on the South-Eastern Railway, and Preece's on the London and South-Western.

Since 1878, however, some of the London, Chatham, and Dover Railway Company's mail trains have been fitted with Varley and Martin's system.

The Preece, the Walker, and the Varley-Martin systems resemble each other in the particular that with each of them only one insulated wire is employed; the railway metals and screw-coupling drawbars being relied upon to provide a return wire, or earth connection; and they are all worked on the electrical principle that was first applied to this kind of communication by Preece in 1864; but each has a different method of coupling the insulated wire between vehicles, and a different kind of alarm communicator for the use of passengers.

The Preece coupling rope is formed of three stranded copper wires, insulated with india-rubber and covered with a thick plaiting of hemp. This rope is brought from the insulated line wire through the buffer beam of one vehicle, and has at its free end a galvanised iron eye that engages with a gun-metal hook fixed on the buffer beam of the oppo-

site vehicle, and is pressed firmly to it by a strong flat spring.

Each buffer beam has a coupling rope at one end, and a gun-metal hook at the other, both connected to the insulated line wire, so that a double electrical connection is made between vehicles, and the couplings are always ready for joining, no matter which end of a vehicle is presented.

The Walker coupling is a hard brass wire spiral enclosed in a vulcanised india-rubber tube. The spiral has a brass ring at each end, and a brass hook to receive the rings is connected with the insulated line wire and fixed at the centre of each end of a vehicle near its roof. These couplings are removed at the end of a journey and transferred to another train, or stored.

The Varley-Martin coupling rope is made by wrapping seven wires round seven hempen cords, each wire round its separate cord, and making them into a rope bound together by two servings of hemp soaked in an insulating compound. Malleable cast-iron eyes are attached at the ends of the connecting ropes, where the couplings are made, and these pass over and are firmly grasped by strong malleable iron hooks, actuated by powerful springs placed in cast-iron boxes attached to the carriages. The eyes are coated with copper, and the hooks with brass, at the points of electrical connection.

With this coupling, as with the Preece coupling, a double connection is made between each vehicle.

None of the three couplings described will give any signal in case a portion of a train is separated on a journey, but each inventor has a plan for providing such a signalling arrangement where it is required.

Colonel Binney employed two wires for his system of intercommunication, as it was tried on the Great Eastern Railway in 1872. The wires were led over the roofs of the vehicles, and connected by a hook and eye and flat spring between them.

Description has been confined to the various kinds of coupling employed by inventors of electrical systems of intercommunication, because the coupling is the only really difficult part of any such system. Once a simple and effective coupling for the insulated wire is secured, it is only necessary, for the establishment of satisfactory intercommunication in a railway train, to have strongly made bell and battery arrangements, that will stand the shaking given to them by the moving train, and to keep the apparatus under efficient supervision.

The method of making the electrical connections to the bells and batteries employed will depend upon what facilities for intercommunication are required.

If it is sought only to provide that passengers and guards may ring to the engine driver, an electric bell, without battery or contact maker, will be required on the engine, a battery and contact maker in the front brake van, a contact maker only in the rear brake van, and an alarm communicator in each compartment of the carriages whence it is intended that passengers may ring to the engine driver.

But, if it is intended that passengers shall be able to ring to the guards as well as to the engine driver, that guard may ring to guard or driver, and that the driver may ring to the guards, it will be necessary to have an electric bell battery and contact maker on the engine and in each guard's brake van, as well as an alarm communicator in any compartment of a carriage whence passengers are to be allowed to ring the bells.

This plan is herewith illustrated, together with a method proposed by the writer for connecting an indicating bell to direct the guards to the compartment of a carriage whence an alarm has originated. A train composed of an engine, thirteen passenger coaches, and two brake vans has been fitted up on the Great Indian Peninsula Railway in the manner shown by the diagram (fig. 1), and is running daily on the local service between Bombay and Kalyan, in order to ascertain by experiment whether an electrical system of intercommunication will meet the requirements of Indian railway traffic, and to practically test a form of coupling for connecting the necessary insulated wire between carriages and an alarm communicator that have been recently designed and patented by the writer.

The coupling now under trial upon the Great Indian Peninsula Railway was designed especially with a view to suit trains that have their composition varied many times during a journey, as is the case with the mail and other through trains upon that line. With such trains the risk that a shunting porter may forget to unhitch anything that will not prevent vehicles from separating, is repeated so often during the run of a train, that it is very important to have the electrical coupling for intercommunication purposes

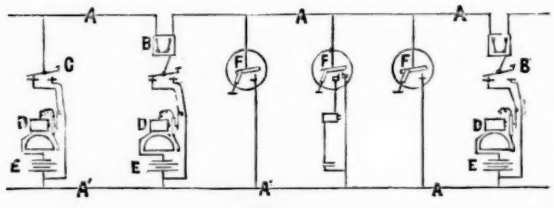


FIG. 1.

Diagram showing electrical connections in a train composed of one engine, two brake-vans, and three carriages. Centre carriage fitted with local bell and battery to indicate where alarm originated.

A, line-wire. A', return, or earth-wire. B, switch. C, contact maker. D, electric bell. E, battery. F, alarm communicator for carriage, *not* fitted with local indicating bell and battery. F', alarm communicator fitted with local indicating-bell and battery.

so arranged that if the shunter should forget to cast it loose it will become uncoupled immediately one vehicle moves away from another, and will not become damaged in the process.

The coupling (fig. 2) is formed by two pieces of metal

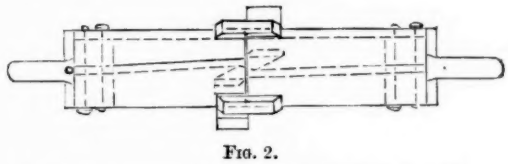


FIG. 2.

Coupling to connect insulated line-wire between vehicles.

tube, each 3 inches in length and $1\frac{1}{4}$ inch in diameter, and closed at one end. A strong flat spring, fixed at the closed end of each piece of tube, projects half an inch beyond the open end, and carries at its free extremity a wedge-shaped piece of metal.

When two pieces of tube are brought together, and one wedge-shaped piece is forced over the other, as shown in fig. 2, a good electrical contact is made and the coupling is complete.

There is a slotted piece on one side and a stud on the other of each piece of tube to act as guides and to prevent any circular movement of the parts after they have been connected.

The insulated line wire is fastened to a ring at each end of the complete coupling, and is carried thence to the centre of the width of the carriages at such a height as to be well clear of the screw couplings and side chains of the vehicles. The coupling hangs in the centre of the space between two vehicles, and can only be separated by a direct strain. The amount of the strain required may be regulated by the strength of the springs in the tubes, and the shape of the wedge piece. The couplings employed on the Great Indian Peninsula train separate at a direct pull of 20 lbs.

For the return or earth wire the writer prefers to use the permanent way rails connected *viâ* the wheels of the vehicles of the train, and supplemented by the screw coupling drawbars joined together underneath each carriage by wire spirals, but if such an arrangement should prove to be unreliable in India, as has been suggested—although it has been found perfectly reliable in England for the past sixteen years—the coupling under description may be readily made to couple up a return wire as well as the insulated line-wire. For this purpose it will only be necessary to fasten the fixed end of the flat spring of each piece of tube in a block of ebonite instead of in metal, thus insulating the spring from the tube. Then the spring will couple the insulated line wire; and the metal case, slotted pieces, and studs of the tubing will couple the return wire; thus the rails of the permanent way will no longer be required to complete the electrical circuit. In connection with most of the elec-

trical systems that have been brought forward provision has been made for giving a signal in case any part of the train should become separated, but, so far as the writer is aware, none of the plans for that purpose have been brought into practical use upon railways. It is an objection to such a signal that unless some more or less complicated machinery is added to the ordinary electrical apparatus employed in intercommunication systems, the signal given when part of a train breaks away must of necessity appear to engine drivers and guards exactly like the signal given by a passenger whose alarm communicator is intended to give a peremptory order to stop the train; therefore there would be risk that the train might be stopped by a break-away-signal being mistaken for a passenger's signal, and a collision might result from the hinder part of the train that had separated running into the foremost part. Such liability to mistake, and consequent danger, might perhaps be prevented by some such arrangement as the following.

In each carriage have a train of clock-work to drive a small wheel that has parts of its periphery insulated, and parts making rubbing contact with a flat spring, every time the wheel revolves. Connect the wheel and spring in the intercommunication circuit.

Arrange passenger's alarm communicators in each carriage, so that any one of them will start the train of clockwork when a passenger gives an alarm signal. Then the ringing of the bells on the engine and in the guards' brake vans, instead of being continuous will be interrupted at regular intervals, and thus clearly show that the alarm signal has been given by a passenger.

Each carriage may have the periphery of its clockwork wheel differently insulated from the others, so that signals given by passengers will not only be identified as such, but the particular carriage that a signal comes from will also be told to driver and guards.

But such a plan would be somewhat expensive, and would introduce complication where extreme simplicity is much to be desired. As, however, railway authorities who regard a break-away signal as an important requirement of an electrical intercommunication system in trains, may see some way of overcoming the difficulty proceeding from similiarity of signals without incurring serious expense or introducing complications, the writer has devised an adaptation of his coupling that provides for a continuous signal identical with that given by a passenger being given if any part of a train should become separated on a journey.

In this adaptation of the coupling the springs are insulated from the tubes, so that neither the permanent-way rails nor the screw couplings are brought into use to complete the electrical circuit for the intercommunication, and a small lever is so arranged in each piece of tube that it is insulated from the wedge-shaped piece on the flat spring as long as the coupling remains connected up, but immediately the coupling is separated the small lever is forced hard on to the wedge piece, and makes full contact between the insulated flat spring connected to the line-wire and the metal case, slotted pieces, and studs connected with the return wire. Thus the bells on the engine and in both guards' brake vans will ring continuously, precisely as they would do if a passenger had given an alarm. It is claimed for the coupling described above that it is simple in construction and very strong, that it may be made of inexpensive materials—the cases may be made of iron gas-pipe, if desired—that it assures perfectly safe electrical contacts which are cleaned by the separation, or re-connection, of the coupling—that it may be used either with or without employing the rails of the permanent way for a return wire, and that it may be readily adapted to giving an alarm in case part of a train should become separated on its journey.

Also that, by means of spare lengths of insulated wire rope having a half couping at each end, any number of vehicles not fitted with the electrical intercommunication system may be bridged over, so that they will not interfere with signals passing through the electrically fitted portion of the train: and that any description of rolling stock may be fitted with the electric rope and couplings as quickly as it could be fitted with the "cord," so that railway companies employing the writer's system need only have electric ropes permanently fixed to stock that is constantly running, or that is required to be provided with alarm communicators for the use of passengers; vehicles only occasionally running remaining unfitted with electric ropes and couplings, except when they are actually in work.

The alarm communicator, fig. 3, to be fixed in railway carriages for the use of passengers, has a neat teakwood case—not shown in the figure—from which only the cross-piece, H, projects. A passenger having pulled this cross-piece downwards once, the tongue, T, is removed from a slot on the lever, L, and the latter, being released, falls upon

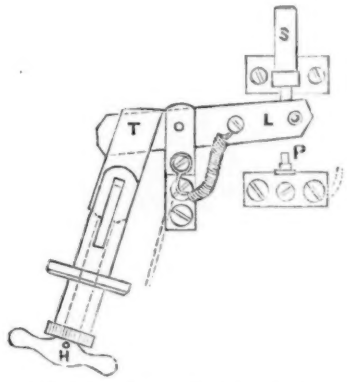


FIG. 3.—ALARM COMMUNICATOR.

the contact point, P, assisted thereto by the helical spring enclosed in the tube, S, thus connecting the line-wire with the return wire or earth (*see* fig. 1) and causing the bells on the engine and in the brake vans to ring continuously until the guard unlocks the teakwood case and restores the lever and handle to their normal positions. The passenger cannot put the handle back until the case has been unlocked, because the tongue, T, cannot enter the slot on the lever, L, until the latter has been lifted clear of P.

In case it is required to have an indicator to direct the guards to the particular carriage whence an alarm has been given, the alarm communicator lever, L, is slightly lengthened, and an additional contact point is placed alongside P, but insulated from it—this extra contact point connects with a small electric bell, and thence with a battery that is connected with P (*see* fig. 1). Then, when a passenger releases the lever, L, it falls on both contact points, thus establishing its own circuit as already described, and also completing a local circuit that causes the small bell in the carriage to ring out a direction to a guard passing alongside the train as to where he should look for the originator of the alarm signal.

The switch shown in each brake van (fig. 1) is to enable the front guard to communicate with the engine driver only, without ringing the rear brake van bell, or to communicate with the rear guard only, without ringing the engine bell. For the former purpose he disconnects the bar nearest to the rear of the train from its lower terminal, and keeps the bar nearest to the engine connected up as shown in the diagram, and for the latter purpose he disconnects the bar nearest to the engine, and keeps the bar nearest to the rear of the train connected up. The switch is only required in the front break van, but as any brake van may be placed in front of a train, it is necessary to fit every vehicle of that class with a switch.

ON CONTACT ELECTRICITY GRADUALLY DEVELOPED UNDER CO-OPERATION OF THE AIR.—By W. Holtz.—The author stretched out an insulated sheet in the air, and placed it in connection, by means of a wire, with the lower plate of a condenser, the upper plate of which was conducted off. If the wire touching the sheet was of copper, the electroscope, after a time, indicated positive electricity; but if it was of zinc, it indicated negative electricity. At times the electric movement was manifest after a short time, but on other occasions only after the lapse of hours if the air was moist, and especially if it contained ozone. Various modifications of the experiment left it free from doubt, that the ultimate source of the electricity was the contact of the sheet and the wire.—*Wiedemann's Beiblätter.*

EXTRACT FROM SPECIFICATION OF PATENT FOR ELECTRIC LIGHTING.

[Dated 6th July, 1852. No. 14,198. By MARTYN JOHN ROBERTS.]

THE following description of an Incandescence lamp sent to us for publication by a friend will be found interesting to our readers. The "Roberts" Arc lamp can be found in the admirable work just issued by our Contemporary *Engineering* on "Electric Illumination."

"Another part of my invention consists of a mode of obtaining electric light by passing a current of electricity through a thin piece of graphite, coke or carbon, or other infusible body, being a conductor of electricity, while it is enclosed in a vacuum or space not containing any oxygen or other matter which can cause the combustion or destruction of it to be brought into an incandescent state by the action of the current of electricity.

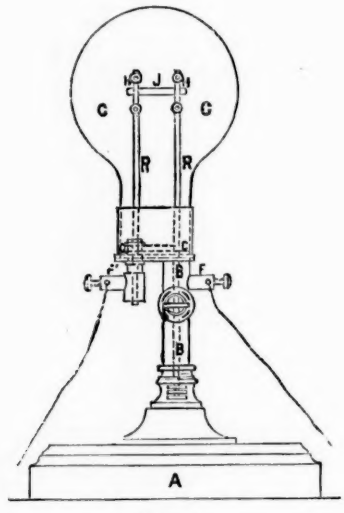


FIG. 5.

"In fig. 5, I have shown an elevation or side view of an apparatus which may be used for this purpose, but I desire it to be understood that I do not claim any of the elements or parts of which this apparatus is composed, apart from the combination thereof. In this figure, A is a stand, upon which a hollow pillar or tube, B, can be screwed; this tube is furnished with a stopcock, S, by which its passage can be closed air-tight. On the top of the pillar is a screw, C, about one and a half inches in diameter, which receives the neck of the globe, G, also furnished with a cap and screw to allow it to be screwed air-tight down upon the tube, B. The tube, B, has a binding screw, F, soldered to it for the purpose of making connection with a galvanic battery, and the tube is also in metallic connection with a rod, R, having at the end of it a clip, H, for the purpose of holding a piece of graphite or other substance, through which I wish to pass the electricity. Another rod, R^1, also furnished with a similar clip, H, passes through the head of the pillar or tube, B, but is preserved from coming into metallic contact with it by having the rod enveloped in ivory or other non-conductor of electricity. At the bottom of the rod, R^1, is another binding screw, F^1, for the purpose of connecting it with the other pole of the battery. Now, the mode of operation with this apparatus is as follows:—A piece of very thin graphite, about half an inch long, half an inch wide, and as thin as conveniently can be made, is fastened at each end into the clips, H and H, and firmly secured; the globe, G, is screwed air-tight upon the pillar, B; the stopcock, S, opened; and the whole apparatus, by a screw at the bottom of B, screwed down upon an air-pump or exhausting syringe; by this the air is drawn out of G, and as perfect a vacuum as can conveniently be made obtained; when this is done, the stopcock is shut, and the apparatus is then removed from the pump to its stand, A, and a galvanic battery is put into connection with it by the binding screws, F, F^1; the electricity passes through the rods, and the thin piece of graphite, J, which becomes white-hot from the passage of the electric current, and no combustion will ensue if the vacuum be perfect and no matter within the globe to cause combustion of the graphite; or if the graphite be not otherwise destroyed, the light continues as long as the electricity flows through the graphite in sufficient strength.

"And with respect to this part of my invention, I claim the production of light by passing electricity through a thin infusible body, being a conductor of electricity, in manner hereinbefore mentioned.

"Another part of my invention consists of a mode or modes of giving increased brilliancy to the light produced by electric lamps.

"I have discovered that flame, or the combustion, or volatilisation of some substances, between or on the points of the electrodes, will very much increase the light produced by an electric lamp. Thus, if a candle or lamp be placed so that its flame shall pass between the points of the electrodes, the brilliancy of the light evolved between the electrodes will be increased; or if lime or any other alkaline earth be interposed between the electrodes in this manner, I prefer to effect that object in the same manner as lime is introduced between two jets, in what is usually called the Drummond light; I prefer, however, to produce the same, or nearly the same effect, by a new description of electrode, which I make by mixing the material of which the electrodes may be composed with a portion of lime or other alkaline earth (I have used about 5 per cent. of lime with success), taking care not to introduce as much as will materially diminish the power of the electrodes to conduct electricity. When electrodes thus made are brought into action in the lamp, they produce a light very much more brilliant than electrodes made without any such admixture."

The similarity of this latter arrangement to recent patented devices will be obvious.

THE BRITISH ASSOCIATION.

[*Specially reported for the* ELECTRICAL REVIEW.]

THE EFFICIENCY OF THE EDISON STEAM DYNAMO.

[Paper read before Section G, Monday, August 28th, 1882, by Dr. FLEMING.]

EXPERIMENTS were carried out during the month of June last, at the central station of the Edison Electric Light Company, London, by Dr. Hopkinson and myself, on the efficiency of the steam dynamo which supplies the current for lighting their district. The results which we obtained appear to be in accordance with some others obtained in America. Four machines only are in existence in Europe of the type used at the Holborn headquarters. The first was exhibited in Paris, the second and third are now in London, and the fourth is on its way to Milan, together with another machine, for supplying 2,000 lights to the theatre there. They are all of the same general type, though, with certain slight modifications, the machine is, of course, simply a revolving armature, in which the conductors are not wires but copper bars. This revolves in the field of a very powerful magnet, or rather of a series of 12 magnets, which are coupled six in series, and then joined in parallel arc. The current is taken off by brushes. In the first machines there were only three brushes, in those now employed there are four; in the machine going to Milan there are five, of about 2½ inches wide. The effect is to reduce the sparking very considerably, and the machine runs with its full load sometimes almost entirely without a spark.

In our investigations we intended to elicit an answer to the question: What horse-power fraction of the power employed in turning it comes out of the dynamo in the shape of electric current—including the part that is used to supply the magnet? The engine is a Porter-Allen of the usual type, which turns directly upon a shaft which runs direct through four bearings. Our first attempt was to measure the power applied on the axle of the armature. For that purpose we used a high-speed indicator. As the speed is 290 to 300 revolutions a minute, the indicator turns six times a second. We took it at various times with various conditions of load. Many of the diagrams we got had to be rejected, but we got some that were good, and these were collected and copies made by the electric pen. They were laid down and a stencil proof taken, and from that the horse-power was taken off very accurately. At the same time there were recorded the pressure in boiler, speed of engine, load of lamps, and the time at which the observation was taken. Very special

arrangements were made to ascertain the exact number of lamps in the circuit during the observations. They were scattered through the whole district, and could not, of course, be stopped at any given moment after they had been started for the night. We were not able to contrive a shunt at that time to measure the power generated, and also the difference of potentials between the two poles, but we got at these results in an indirect way. We were enabled to measure not only the difference of potentials between the two mains, but the current flowing, and, therefore, we had the means of knowing the energy expended in the circuit. Simultaneously with these observations we made others on the candle-power of the lamps, so as to keep that constant in our calculations. Of the current which comes out of the dynamo, more or less, can be thrown into the magnets; and, by altering the current, the whole of the lamps can be raised or lowered so that they can be kept constantly at 16-candle power. Experiments with the series of indicated dynamos were taken to indicate the power consumed simply in turning the machine at a normal speed when no current was generated. For that purpose the switches which connected them with the magnets, and also the main circuits, were opened, and the engine was run at its speed of 290 to 300 revolutions. The results observed were plotted down as a curve in a large diagram, where the abscissæ were taken to represent the number of lamps and the ordinates the horse-power. Immediately after that the field circuit was closed, the external remaining open. So that the diagrams taken represented the difference between the two energies or the horse-power employed or consumed in maintaining the current in a field magnet, and also local currents in the coil and armature. That difference we found to be 19·77 horse-power. With these safeguards, then, we found that for 200 lamps we had an expenditure of 43·45 horse-power; for 600, 105 horse-power; for 800, 117 horse-power; for 1,000, 145 horse-power. Deducting the 19·77 horse-power occupied in charging the field and overcoming the friction, a total of 125 horse-power remained as occupied in maintaining 1,000 lamps. The result, therefore, is that, after overcoming the friction, the addition of eight 16-candle lamps makes a difference of one additional indicated horse-power. The efficiency so stated is a compound efficiency—partly of dynamo and partly of lamp. The 10-candle lamps have a resistance of 200 (20?) ohms when hot, and the 16 only 140 ohms, so that with only half the current and horse-power the latter yield 25 per cent. more light. To separate the efficiency of the dynamo from the lamp, we did not, for want of time, make accurate experiments to measure the current directly, but we made arrangements for ascertaining what was the actual current going out. We could get this from our diagrams. The observations on the difference of potential between the poles of the machine showed that the machine was generating 105·5 volts as the mean. The resistance of the field-magnets taken as the constant is 6·73 ohms. The magnets are twelve in number, and the coils are coupled six in series and two in multiple arc. Therefore the energy represented by the current in the field is $\frac{105 \cdot 5^2}{6 \cdot 73}$, or 1,654 Watts, or two horse-power. The total power was 19·7 horse-power. Deducting from this 8 for friction and 2·2 represented by the energy of the field current, we have 9·5 as waste in local current and in the armature bars. We have, then, on the whole, 17·56 horse-power as ineffective in producing current when the dynamo is running with 1,000 candles. The total horse-power ought to be 125. The efficiency of the dynamo is the difference, or 88 per cent., or nearly 90 per cent. This efficiency increases with the number of lamps, and as the machine will bear loading up to 1,300 before the external resistance becomes too small, and the armature begins to heat, a slightly higher efficiency can be obtained. Special tests on the efficiency of the lamp, to determine the actual horse-power expended in the carbon, showed that with a lamp of the old form burning at 16 candles, the electromotive force 105 volts and the current per lamp ·7 of an ampère, the result was 73·85 Watts = 1-10th horse-power as the energy expended in the carbon itself. From the horse-power curve another useful series of facts could be obtained. We were able to plot another curve, of which the abscissæ represented *time* and the ordinates *horse-power* equivalents, so as to express the work of the engine in horse-power hours. Other experiments of less general interest were made at the same time on the efficiency of the boiler. The results, therefore, carried out with very considerable care, show that this dynamo has the power of converting into energy of electric current some 90 per cent. of the energy applied to turn the armature of the machine.

The President said that it was only upon such experiments as these that the public were enabled to form an opinion on the subject. Discussion being invited,

Mr. Blakeley said that they did not yet know the exact laws upon which the transmission of energy took place. He had never seen a satisfactory expression for the work of one of these machines, from which one could deduce the connection of the current with the velocity and the resistance which were the three variables in the problem which the engineer required to solve before he could be thoroughly answerable for the action of these machines. They heard a great deal about the characteristic curve of a machine; here it had been furnished by a series of experiments which only supplied what ought to have been known without them. Problems in dealing with current velocity of revolution and resistance ought not to depend on experiment for their solution. He had himself endeavoured to analyse published figures on the subject. One of the chief things which he really wanted to know was, "Is the alteration which occurs in the magnetic field produced by the revolving armature considered as a metallic mass?" This was most important for the problem, because the effective magnetism is one of the factors in the evaluation of the magnetic force. The best attempt to settle that law had been made by Mr. Siemens and described in a paper given before the Society of Arts in May, 1881. That paper assumed the reduction of the magnetism from what it would be when the armature did not revolve in the field, to be proportional to that magnetism and to the velocity of rotation. But it has since been shown that the velocity of the following machine is greater than that of the driver, a very odd thing indeed, and one which entirely did away with the hypothesis of Mr. Siemens that the magnetism in the second machine would be increased by the revolution of the armature.

Mr. Macknight, Edinburgh, followed with a few remarks on the practical results of these machines as exhibited in actual lighting, contending that frequently the cost of the system was a bar to its adoption.

RECENT PROGRESS IN ELECTRIC RAILWAYS.

[Paper read before Section G, Monday, August 28th, 1882,
By Dr. FLEMING.]

Mr. EDISON has for some time been struck by the economy involved in an electric system of transport, and has set himself to design an electric locomotive, taking as his type the ordinary steam locomotive, only he has taken out all the interior mechanism and replaced it by mechanism appropriated to drive the machine by means of an electric current. The general scheme by which this has been done is as follows:—At a certain station there are a series of dynamo machines of the well-known patent of Edison capable of supplying 250 of the ordinary 16-candle incandescent lights. A battery is set up at a central station with mains proceeding out at different points on the railway. The current, when it has entered the circumference of the wheel, passes up into the central hub, and so is taken off by brushes into the dynamos placed in the interior of the engine. Hence it is necessary to have the centre of the wheel insulated from the tyre. The dynamos in the interior are of the same type as made by Mr. Edison for lighting purposes. The armatures are wound on the Siemens principle, and the same peculiarity is preserved in the dynamo of making what Edison calls a large intervening mass of iron. The locomotive, which is attached to the train of cars in the usual way, can be started or stopped by shunting the current into the dynamo, and by varying the external resistance in the field circuit of the dynamo, the engineer or locomotive driver has the power of regulating the speed of the engine. Mr. Edison has so far succeeded in his experiments that they are now travelling on this railway at 40 miles an hour in Menlo Park. The most important question of course is whether this system is or is not more economical than the ordinary steam locomotive, and Mr. Edison's statements as to this are based on the doings of the ordinary locomotive of the best type. In such a locomotive it is not possible to get one indicated horse-power with a less consumption than 6 lbs. of coal per hour, when special attention is given to the firing and running. With careless firing it is possible that there will be a great increase in the consumption of the coal, owing to loss of coal or coke through the funnel. But under this arrangement you can, as it were, transfer the consumption of the coal from the fire-box of the engine to the central station, at which the stationary engines will be of a far more economical type. By using condensing engines of the best type and taking very careful means to economise the consumption of coal, it can be got down to something like 2½ lbs. per horse-power per hour. Therefore there is in the first place a large saving in coal—though it remains to be seen whether what is thus gained is not lost in the transformation of the energy of the coal into electric current. Careful experiments have yet to be made to ascertain the efficiency of the dynamos used: what proportion of the coal-power is transformed into electric current. Some recent experiments in London confirm Mr. Edison's estimate of their efficiency. The result, as far as the experiments have hitherto gone, is that the dynamo machine converts into electric energy more than 90 per cent. of the power applied to turn it. Then, as to the reconversion of the current back again into work, we can also recover in a similar proportion. Of course there is a loss of energy in the electric mains, and also a loss due to leakage on the railway by imperfect insulation; but even allowing as large a margin as 50 per cent. for this, assuming that the Porter-Allen engine gives an indicated horse-power of 2½ lbs. of coal per hour, Mr. Edison finds 5 lbs. per horse-power required for his electric railway, as against six in driving a locomotive. Hence Mr. Edison thinks we may regard these figures as a reliable indication that an electric railway is a more economical means of realising the energy of coal for effecting transport from place to place. Another contrivance which Mr. Edison uses is for the purpose of enabling locomotives to clutch the rails in certain cases where the locomotive has to ascend an incline, so as to obtain a greater hold upon the rails than the simple weight of the engine supplies. In his first dynamos, Mr. Edison communicated the power by belt, but in the latter forms he has adopted an endless screw gearing, which is safer than the belt. In the dynamos which he is using to supply a current from the central station he has adopted the same method of doing away with belt and gearing, and making the engine connect to the armature of the machine, so that I think there will be still greater advances in the economy and efficiency of the machine which he has devised.

Mr. Fowler said that the assumption on which the calculations seemed to be based on the locomotive consuming 6 lbs. of coal per horse-power per hour was nearly twice the actual fact.

Prof. Forbes said that much in this paper required very great consideration before an opinion could be pronounced upon it. They were told that 90 per cent. of the power put into the dynamo was converted into electric current, but they were not told how much of that was used up in rendering the dynamo effective, *i.e.*, in overcoming the internal resistance. That statement was quite distinct from stating that 90 per cent. was being used efficiently. Perhaps about one-half might be used in overcoming internal resistance, so that if they allowed 50 per cent. for leakage and so forth, and a large loss of current in the interior of the machine, it would seem almost impossible to imagine that the cost could be so small as had just been stated.

Mr. F. J. Sprague stated that the ratio of total development of power in these dynamos was 94 or 95 per cent., and he had seen frequently machines of somewhere about 87 per cent. efficiency. He had also seen a dynamo work up to 150 horse-power.

Sir J. Hawkshaw said that they had not sufficient data before them to form conclusions in regard to the efficiency of these electric machines. He certainly did agree with the president of the section, however, in thinking that the consumption per horse-power per hour of coal in the ordinary locomotive was much overstated in these calculations.

Mr. W. Traill said that it was most interesting to hear of the progress that had been made in Menlo Park. The railway of eight or 10 miles in length there was much ahead of those in Europe. The longest on the continent was only about one and half miles. He himself was engaged with one in the North of Ireland, which, when completed, would measure about seven miles. They had not advanced sufficiently far with the railway yet to enable him to enter into details, but it promised to be a complete success. The one great point in these railways was the development of electricity from a stationary engine. In their case, however, they proposed to develop electricity by water power, which they had at immediate command. They all had the most favourable anticipations with regard to its economy.

Dr. Werner Siemens said that at Berlin they had had an electric railway in practical operation for one and a half years. In that time there had been no break down, but during the winter the loss of power on the line is more than one quarter of the power supplied. Another railway at Spandau, a little more than 4½ kilometres in length, had at places an incline of 1 in 28. About 2½ kilometres of it were on the plain. They secured in that case perfect insulation by means of suspended wires. This had worked well and economically.

Colonel Beaumont said that in connection with electric railways attention should be called forcibly to the great sources of electric energy in the water that was everywhere running to waste. He thought that the cause of electric tramways could not be helped by the use of data that were far from being correct. It had been often affirmed that engines used as much as 6 lbs. of coal per horse-power per hour; but the best locomotives of the day, developing as much as 500 horse-power would not use more than 2¼ lbs. per mile running at 40 miles an hour. He should think that 2½ lbs. would be about the mark, and there were engines running in this country developing a horse-power with even less than 2 lbs.—though perhaps not many. If they could have locomotives that would consume 2 lbs. an hour, there was no reason why they should take 6 lbs. as the basis of comparison. Edison's electric railway would then come to just about double the cost of the locomotive system.

Dr. Fleming said that the average locomotive had been taken and compared with the electric railway, and, under the circumstances, 6 lbs. was not an extravagant estimate. Of course, if they assumed a first-class type the basis of comparison was destroyed. With regard to the efficiency of the dynamos, something like 90 per cent. of the power employed to turn the armature was efficient. Of course the difference was accounted for in friction and waste by leakage, &c.

Mr. Fowler said that they might say generally that they had a want of materials to form an opinion on in regard to the subject before them. It was quite clear that much more was needed too before they could arrive at a definite conclusion on the subject. He must entirely demur to the last remark made, that they ought to take an average locomotive as the basis of comparison. Why should they take an absolute thing and compare it with such a development as electricity when they had infinitely better engines at work? On the contrary, they ought to compare the very best of one system with what the other system offered to them. Another point which seemed to escape the discussion was that for a locomotive engine they must use the very best and purest coal, if they had a fixed engine they could use inferior coal. Materials would no doubt be forthcoming, which were as yet lacking, for a due comparison of the cost of the two systems, and these might in some future meeting form the basis of a really valuable discussion. These questions of electric railway or compressed air were particularly interesting at the present time. He looked forward with the greatest possible interest to the accumulation of full and exact details on which trustworthy conclusions could be arrived at respecting them.

ELECTRIC LIGHT ENGINEERING.

[Paper read before Section G, 28th August, 1882,
By Dr. FLEMING.]

In view of the extensive systematising of telegraphic and telephonic systems it becomes of importance to consider whether some extended scheme may not be adopted as the means in future of effecting economy and securing safety in regard to electric lighting. The most costly item in systems of lighting in central stations will be the conducting mains. These should be so laid as to be accessible for repairs, yet out of reach of accident. Arrangements should be made by which any demand for more current should be met with the least waste. In planning any general system a system of cross bracing should be adopted, in such a manner that dependence need not be placed on one main only, but on several distinct mains in case of accident to one main, and in order to equalise the potential of the whole system. In the Edison system the conductors are inclosed in a single iron pipe, but it may ultimately prove that the better arrangement will be to lay copper bars insulated in an iron trough along the side walk, which could be laid in sections and flush with the pavement. Such an arrangement could be made watertight, and there would be great facilities both for repairs and tests. Too much stress cannot be laid on jointing. In telephone work, of course, imperfect joints are of small importance, but in a current of several ampères a bad joint may be a serious drawback. At every central station insulation tests at the circuits ought to be taken, and the faults examined and corrected. It ought to be possible to restrict the loss of leakage to 1 per cent. or less of the whole output of the current. All switches intended to break circuits should be so arranged that the current is broken at several places simultaneously. By this means sparking is reduced. Within the building every precaution should be taken that no part of the person of a visitor, workman, or loiterer should form part of the circuit. The whole of the electric conducting-wire should be under cover, though accessible. Passing to the considerations which should guide in the determination of the size of radius it is obvious that this is not a matter of indifference. The conductivity is proportional to the mass, and for unit of length proportional to the resistance. And this unit of length is universally as the cross section, hence we may easily see that there must be some section that will give a current which will be a section of greatest economy, for if the size of the copper be excessively large the waste of copper will be very great, though the waste of energy is very small. If, on the other hand, the copper be excessively small, the waste of energy would be very great. Hence there was a minimum of size for a maximum of economy, and that can be shown to be the case when the interest on the cost of the mains is equal to the actual cost of the energy wasted in them. But two factors largely determine these—price of copper and price of power. Accordingly, in places where the power is cheap, as where coal is cheap, or where water power can be secured, a very much smaller size of main conductor is necessary than in places where coal is dear or power expensively obtained. Another point with which we are concerned here is the size of the conductors, which must be taken with a view to their not overheating. The heat generated in the conductor is not wasted, but accumulates and raises the temperature, and experiment should decide the size of the wires for a particular current.

The safety catch should be so arranged that it fuses well below the strength of current at which the wires begin to feel warm. It should be borne in mind that systems which work with currents of low potential require precautions against fire just the same as those which use a high potential. No doubt it will ultimately prove necessary to have regulations to decide what is sufficient insulation. In the memorandum put forward by the fire insurance authorities the remark occurs that the main should be sufficiently insulated. Regulations are laid down for the weight of lead pipe, and its size; it must bear a given pressure of water. It ought, however, to be determined what insulation is necessary, and what is sufficient security for electric mains. One other question remains to be dealt with in conclusion, and that is the arrangements that should be made for the measurement of the light. Lighting may be carried on by contract as gas lighting, but for domestic purposes there is no doubt that lighting must be performed by means of a measured electric current. One important consideration in respect of all forms of electric meters is that they ought to be very carefully inspected, to see if they really indicate ampère-hours correctly. It is not sufficient merely to pass the same current through two meters and see if they register the same amount. The important thing to ascertain is whether the meter does register ampère-hours correctly when the two factors are greatly varied—*i.e.*, it should be seen whether a current of 100 ampères for one hour causes a meter to register the same as a current of one ampère for 100 hours. It is not possible to arrange for the correct measuring of the light when the meters vary according to the variation in the factors when thus tested.

ON THE ABSOLUTE MEASUREMENT OF ELECTRIC CURRENTS.

[Paper read before Section A, Friday, August 25th, 1882,
By Lord RAYLEIGH.]

THE accurate absolute measurement of currents seems to be more difficult than that of resistance. The methods hitherto employed require either accurate measurements of the earth's horizontal intensity, or accurate measurements of coils of small radius and of many turns. If in the latter measurement we could trust to the inextensibility of the wire, as some experimenters have thought themselves able to do, the mean radius could be accurately deduced from the total length of wire and the number of turns, but actual trial has convinced me that fine wire stretches very appreciably under the tension necessary for winding a coil satisfactorily. Kohlrausch's method, in which the same current is passed through an absolute galvanometer, and through a coil suspended bifilarly in the plane of the meridian, is free from the above difficulty, but it is not easy so to arrange the proportions that the suspended coil shall be sufficiently sensitive, and the galvanometer sufficiently insensitive. In this method, as in that of the dynamometer, the calculation of the forces requires a knowledge of the moment of inertia of the suspended parts. When the electro-magnetic action is a simple attraction or repulsion, it can be determined directly by balancing it against known weights. In Mascart's recent determination a long solenoid is suspended vertically in the balance, and is acted upon by a flat co-axial coil of much larger radius, whose plane includes the lower extremity of the solenoid. This arrangement, though simple in theory, does not appear to be the one best adapted to secure precise results. It is evident that a large part of the solenoid is really ineffective, those turns which lie nearly in the plane of the flat coil being but little attracted, as well as those which lie towards the further extremity. The result, calculated from the total length of wire (even if this could be trusted), the length of the solenoid and the

number of turns, has an appearance of accuracy which is illusory unless it can be assumed that the distribution of the wire over the length is strictly uniform. It would appear that all the turns of the wire should operate as much as possible, that is, that the suspended coil should be compact, and should be placed in the position of maximum effect.

There is a further incidental advantage in this arrangement, which it is the principal object of the present note to point out. The expression for the attraction involves as factors the product of the number of turns, the square of the current, and a function of the mean radii of the two coils and of the distance between their mean planes. Now, as may be seen from the fact that the square of a current is already of the dimensions of a force, this function of three linear quantities is itself of no dimensions. In determining its actual value we should, in general, be subject to three errors, but when the position is such that the function (for two given coils) is a maximum, the result is practically dependent only upon the two mean radii, and being of no dimensions can involve them only in the form of a *ratio*. In order then to calculate the result, all that it is necessary to know with precision is the ratio of the mean radii of the two coils. This ratio can be obtained electrically with full precision, and without any linear measurements. For if the two coils, considered as galvanometer coils, are brought co-axially into the same plane, the ratio of their constants can be found by the known method of dividing a current between them in such a way that no effect is produced upon a small magnet suspended at the common centre. The ratio of the resistances in multiple arc gives the ratio of the currents, and this again, subject to small corrections for the finite size of the sections, gives the ratio of the mean radii.

It appears that in this way all that is necessary for the absolute determination of currents can be obtained without measurements of length or of moments of inertia, or even of absolute angles of deflection. In practice it will be desirable to duplicate the fixed coil, placing the suspended coil midway between two similar fixed ones through which the current passes in opposite directions. A rough approximation for the condition of things above described will be quite sufficient.

EQUILIBRIUM OF LIQUID CONDUCTING MASSES CHARGED WITH ELECTRICITY.

[Communicated by LORD RAYLEIGH to Section A, Friday, 25th Aug.]

IN consequence of electrical repulsion a charged spherical mass of liquid unacted on by other forces is in a condition of unstable equilibrium. If a_0 be the radius of the sphere, Q the charge of electricity, the original potential is given by

$$V = \frac{Q}{a_0}$$

If, however, the mass be slightly deformed, so that the polar equation of its surface expressed by Laplace's series becomes—

$$r = a(1 + Y_1 + Y_2 + \dots + Y_n + \dots)$$

then

$$V = \frac{Q}{a_0}\left\{1 - \Sigma(n-1)\iint \frac{Y_n^2 d\sigma}{4\pi}\right\}$$

and the potential energy of the system reckoned from the equilibrium position is—

$$P^1 = -\frac{Q^2}{8\pi a_0}\Sigma(n-1)\iint Y_n^2 d\sigma$$

In actual liquids this instability indicated by the negative value of P^1 is opposed by stability due to the capillary force. If T be the cohesive tension, the potential energy of cohesion is given by—

$$P = \tfrac{1}{2}a_0^2 T\,\Sigma(n-1)(n+2)\iint Y_n^2 d\sigma^*.$$

If $Y_n \propto \cos(pt + \epsilon)$ we have for the motion under the operation of both set of forces—

$$p^2 = \frac{n(n-1)}{\rho a_0^3}\left\{(n+2)T - \frac{1}{4\pi}\frac{Q^2}{a_0^3}\right\}.$$

If $T > \frac{Q^2}{16\pi a_0^3}$, the spherical form is stable for all displacements. When Q is great the spherical form is unstable for all values of n below a certain limit, the maximum unstability corresponding to a great but still finite value of n. Under these circumstances the liquid is thrown out in fine jets, whose fineness, however, has a limit.

The case of a cylinder, subject to displacement in two dimensions only, may be treated in like manner.

The equation of the contour being in Fourier's series—

$$r = a(1 + Y_1 + \dots + Y_n + \dots),$$

we find as the expression for the potential energy of unit length—

$$P' = -\frac{Q^2}{l^2}\Sigma(n-1)\int \frac{Y_n^2 d\theta}{2\pi},$$

Q being the quantity of electricity resident on length l.

The potential energy due to capillarity is

$$P = \tfrac{1}{2}\pi a T\,\Sigma(n^2-1)\int \frac{Y_n^2 d\theta}{2\pi}$$

and for the vibration of type, n, under the operation of both sets of forces—

$$p^2 = \frac{n^2 - n}{\rho a^3}\left\{(n+1)T - \frac{2Q^2}{\pi l^2 a}\right\}.$$

The influence of electrical charge in diminishing the stability of a cylinder for transverse disturbances may be readily illustrated by causing a jet of water from an elliptical aperture to pass along the axis of an insulated conducter tube, which is placed in connection with an electrical machine. The jet is marked with a recurrent pattern, fixed in space, whose wave-length represents the distance travelled by the water in the time of one vibration of type, $n = 2$. When the machine is worked the pattern is thrust outwards along the jet, indicating a prolongation of the time of transverse vibration. The inductor should be placed no further from the nozzle than is necessary to prevent the passage of sparks, and must be short enough to allow the issue of the jet before its resolution into drops.

The value of T being known (81 C.G.S.), we may calculate what electrification is necessary to render a small rain-drop of, say, 1 millimetre diameter unstable. The potential expressed in electrostatic measure is given by—

$$V = \frac{Q}{a_0} = \sqrt{(16\pi a_0 T)} = 20$$

The electromotive force of a Daniell cell is about ·004, so that an electrification of about 5,000 cells would cause a division of the drop in question.

ON THE DURATION OF FREE ELECTRIC CURRENTS IN AN INFINITE CONDUCTING CYLINDER.

[Communicated to Section A, Friday, 28th August, 1882, by LORD RAYLEIGH.]

TAKING the axis of the cylinder as that of z, we suppose that the currents are functions of—

$$\sqrt{x^2 + y^2}$$

or r only, and flow in the circles r = constant.

From the equations given by Maxwell's "Electricity," Vol. II., § 591, 598, 607, 610, 611, we may deduce for a conductor of constant, μ—

$$\left(\frac{d^2}{dx^2} + \frac{d^2}{dy^2} + \frac{d^2}{dz^2}\right)c = 4\pi\mu C\frac{dc}{dt}$$

with similar equations for b and a.

In the present case the magnetic forces b and a vanish, and c is a function of r only. Thus—

$$\left(\frac{d^2}{dr^2} + \frac{1}{r}\frac{d}{dr}\right)c = 4\pi\mu C\frac{dc}{dt}$$

or if c and e^{nt}

$$\left(\frac{d^2}{dr^2} + \frac{1}{r}\frac{d}{dr} + 4\pi\mu n \cdot C\right)c = 0$$

the solution of which, subject to the condition of finiteness at the centre is—

$$c = A J_0\left(\sqrt{4\pi\mu n C}\, r\right)$$

To determine the admissible values of n we have only to form the condition which must be satisfied at the boundary of the cylinder, $r = R$. It is evident that the magnetic force must here be zero, and for that the condition is—

$$J_0\left(\sqrt{4\pi\mu n C \cdot R}\right) = 0$$

The roots of the functions are 2·404, 5·520, 8·654, 11·792, &c. For the principal mode of longest duration—

$$C = A J_0(2{\cdot}4042 \mid R)$$

and

$$n = \frac{2{\cdot}404^2}{4\pi\mu C R^2}$$

If τ be the time in which the amplitude sinks in ratio $e : 1$—

$$\tau = \frac{1}{n} = \frac{4\pi\mu C R^2}{2{\cdot}404^2}$$

For copper in C.G.S. measure—

$$C = \frac{1}{1642},\ \mu = 1, \text{ and then } \tau = \frac{R^2}{800} \text{ nearly.}$$

In order that τ should be one second, the diameter of the cylinder would have to be about two feet.

ELECTRIC LIGHTING AT GODALMING.—It is anticipated that a considerable extension will shortly take place in the electric lighting of this town, that at present in operation having proved highly satisfactory. The water-motor, we hear, has been abandoned, as the water supply was not to be depended on.

* See Proc. Roy. Soc., May 15th, 1879.

BROOKS' UNDERGROUND CABLE SYSTEM.

CONSIDERABLE progress is likely to be made with this system in America owing to the success which has attended the lengths of line already in use, in fact several contracts have already been agreed upon for the laying down of numerous wires on the principle.

Two years ago about 5 miles of the Brooks cable was laid between Jersey City and Newark, this cable crossed the Hackensack and Passaic, and the intervening salt marsh. There were seven test boxes on the route and as many reservoirs of oil. Owing to defects in construction this line did not prove a success, and it was subsequently replaced by a new cable; the latter has but one reservoir instead of seven as on the old line; this reservoir is situated three miles distant from Jersey City at an elevation of 25 ft. above the cable house at the latter place. The insulation resistance of the wires averages from 10 to 15 megohms per mile, an insulation amply sufficient for all practical purposes.

Soon after the completion of the line two of the conductors, which in the first instance were testing well, became damaged by lightning and showed almost full earth, and subsequently the other wires became defective from the same cause. At the time these faults occurred the ends of the cable were unprovided with lightning protectors, but the latter were afterwards fitted. It was at first thought that the faults were caused by the pipe in which the wires were enclosed becoming broken, but as this proved not to be the case a few gallons of the insulating oil were allowed to flow through the pipe, and this caused the faults to gradually disappear, so that all the wires were rendered workable.

Since the lightning protectors (plate) were fixed in position, some of the plates have been fused together by the violence of the discharges, and the papers of every set of plates have been perforated; this shows that the faults which developed in the wires previous to the placing of the protectors were probably severe ones. The possibility of removing lightning faults in the wires is a peculiar and most valuable feature of the Brooks system.

For telephonic purposes the Brooks cable seems eminently adapted, as with a metallic circuit formed from two wires no appreciable inductive disturbance is found to exist, even where very heavy working currents are being transmitted through the adjacent wires in the same pipe.

We believe that the line of 30 conductors, on the Brooks system, laid several months ago between Waterloo and Clapham Junction, on the London and South-Western railway, continues to work most satisfactorily, and has given no trouble whatever. No doubt, should the postal authorities at any future time contemplate constructing a new trunk line, to meet the increasing requirements of the service, the advisability of adopting the Brooks system will be seriously considered, more especially when the comparatively low cost of the invention is borne in mind.

CORRESPONDENCE.

TO CORRESPONDENTS.

No notice can be taken of anonymous communications. Whatever is intended for insertion must be authenticated by the name and address of the writer, not necessarily for publication, but as a guarantee of good faith.

Correspondence should arrive not later than Tuesday morning if it is desired to appear in the following number.

INDIVIDUAL TELEPHONIC CALL BELLS.

To the Editors of THE ELECTRICAL REVIEW.

SIRS,—Having noticed from time to time various accounts of individual call bells for telephone exchanges published in your journal, and having had some experience with such bells in the United States, I take the liberty of offering a few remarks upon that subject. There are something over 480 telephone exchanges, and in the neighbourhood of 72,000 subscribers connected to these exchanges, now in the United States. I think I may safely say that about one half of these exchanges have had some experience in the use of individual calling systems. When I say individual calling systems, I mean an exchange system by which a number of subscribers may be looped in on the same circuit wire, and not only have secrecy of communication with the central office, but never have their bell rung except when they are wanted.

There have been a vast number of inventions made in this country for the purpose of accomplishing this end, and they have all succeeded more or less well. These bells have not, however, been universally adopted by the telephone companies. The inventors would, undoubtedly, say this failure was due to the subscribers, and not the fault of the bells; and I must agree with both managers and inventors, that if our subscribers were only well educated mechanics and electricians, and were as patient as cultivated persons should be, why then an individual call-bell system would be both an economical and temper-saving invention. But in the present ignorant state of the human race in general, the simpler the construction, and, therefore, the operating of a telephone exchange, the more likely it is to be financially successful.

More than half the calls received now by central offices are given by impatient people who want instantaneous communication with some other subscriber, and there is nothing so annoying to such a person as to go to his telephone and find the wire in use, and this often happens upon circuit wires of four or six stations.

As the telephone becomes more and more a necessity to a business man so the more does he make use of it for the transmission of important messages, and he requires great promptness and precision in its working. And it is my experience, and I may say that of nearly all persons connected with the telephones of this country, that the exchanges are gradually changing their circuit wires of a number of stations for direct wires; and this is not wholly due to the imperfection of the bells, but to the fact, as I say, that subscribers are gradually getting to use their telephones for saving minutes and seconds instead of mere playthings. They are more willing to pay a higher rental, provided they can get more efficient service, and such service can only be rendered by a direct wire system. The reasons are obvious. In the first place, the chance of a telephone getting out of order increases directly as the number of stations on the same circuit wire. Secondly, on circuits of a large number of stations the chance of delay on account of the wires being in use is very much greater than in the case of a direct wire. Thirdly, it takes much longer to call and make connections where an individual bell circuit system is employed than in the case of a direct wire system.

It is, however, undoubtedly necessary for most small exchanges—especially those in small country towns—to make use of some form of circuit wire system to a limited extent, on account of the long distances wires have to be run to reach subscribers and the low rates such exchanges are obliged to use; but even in such cases I cannot recommend the use of the individual bell. I believe it is better to limit the number of stations to four that are looped in on the same wire and construct the circuit as simply as possible, using only the magneto, or whatever call bell the exchange may think best, and call by numbers. I fix the limit of stations to four because I do not think that more than that number can be connected without there being danger of subscribers interfering with each other, as they generally want to use their instruments at the same time of day. In America the magneto generator is being universally adopted in place of all other forms of calling apparatus, and some of our best exchanges are using this bell alone upon their circuit lines—calling, as I stated above, by striking the number of the station. I fully appreciate the ingenious inventions of Anders', Bott, Stabler, Brown and Saunders, and Bliss. A circuit thirty-three miles in extent, connecting twelve stations upon which the Bliss individual bell is used, has been constructed for the Croton Aqueduct Company of New York City. This circuit works well, but it must be remembered that it is only used by civil engineers and mechanics, and is only a private line for communication between the offices of the company, so that the chances of its getting out of order are small as compared with our ordinary exchange circuit. Yet, judging from what I have seen of the working of this circuit since its construction, I should say that it was out of order about twelve times as

often as a direct wire exchange connection, or just as many times oftener as there are stations upon the line. In regard to the cost of construction of a direct wire system, of course it is greater than a circuit wire; but, on the other hand, the maintenance is less, and the rates should be regulated according to the distance the subscriber's station is from the exchange central office, and also as to the amount of pole construction necessary in order to make the connection. It is so strong a conviction in the minds of some telephone companies, that circuit wires are not economical, that they decline to build such lines. What I have endeavoured to explain to you is, in short, that, although an individual bell in the hands of competent operators may be in some cases a valuable addition to a telephone circuit, yet I think that experience has shown that, no matter how perfect a machine it may be in the hands of the average subscriber, impatient at every little delay and perfectly ignorant of the instrument he is using, it is not of sufficient practical and economical value to warrant its general use by a telephone exchange.

I remain, Gentlemen,
Your obedient servant,
WILLIAM R. CABOT.

Yonkers, New York, *August 30th*, 1882.

CARBON LIGHTNING PROTECTORS.

To the Editors of THE ELECTRICAL REVIEW.

SIRS,—As paragraphs respecting the resistance of carbon being lowered when heated have appeared—since my letter of 26th August—in the ELECTRICAL REVIEW of the 9th and of the 23rd inst., and the subject is, therefore, still before your readers, I shall be glad, if you will allow me, to ask why the powdered carbon in lightning protectors is at times formed by lightning into a conducting mass. Many cases have come under my notice where the carbon after lightning has become so good a conductor as to form a connection between the line and earth wires, and has thus short-circuited the instruments. A slight tap with a hammer on the wooden portion of the protector is sufficient to separate the mass and set the fault right. Are the powdered carbon transmitters in connection with telephones similarly affected?

I am, Sirs, Yours faithfully,
F. T. J. HAYNES.

Taunton, *September 23rd*, 1882.

[Mr. Varley would probably like to reply to our correspondent's questions on these points, and we feel sure that an explanation from his pen would be most welcome to our readers.—EDS. ELEC. REV.]

THE TELEPHONE.

53, BERNARD STREET,
RUSSELL SQUARE, W.C., LONDON,

JAMES BRAND, ESQ.,
Chairman of the United Telephone Company (Limited).

DEAR SIR,—I have the pleasure to give you notice that I am having made and am selling telephones constructed under Patent 2419, of 1880, Lockwood and Bartlett. I refer you also to my advertisement in the ELECTRICAL REVIEW of the 16th inst., and following Saturdays. I also enclose a circular issued by my manufacturers.

In this telephone "a plate capable of inductive action" is not used, but "a tongue," as in the Reis instrument of 1862, which instrument, Mr. Justice Fry, after hearing the evidence of the witnesses on the part of your company, and the able arguments of the eminent barrister, Mr. Aston, your counsel, decided not to be like unto Bell's instrument, for if it were then Bell's patent would be void because of the prior publication of Reis's instrument in England.

Considering the course heretofore pursued by your company in regard to other inventions, I hereby inform you that I shall take legal proceedings without delay against any and all persons who shall presume to attempt to injure my prospects in the above-named patent, by stating it to be an infringement of Bell's or of any other patent.

Respectfully,
Your obedient servant,
September 26th, 1882. W. C. BARNEY.

[A copy of the above self-explanatory letter has been forwarded to us by Mr. Barney for publication in our columns, together with the circular of Messrs. J. T. Gent & Co., of Leicester, who are manufacturing the instruments referred to. It is not necessary to deal with the latter, as it simply gives the list of the low prices at which these telephonic instruments are supplied, and the opinion amongst others of Mr. C. F. Varley, who states that the Lockwood & Bartlett Telephone does not infringe the patents of Edison or Bell.—EDS. ELEC. REV.]

THE GÜLCHER ELECTRIC LIGHT.

To the Editors of THE ELECTRICAL REVIEW.

DEAR SIRS,—I observe that in your notice of the electric lights at the North-East Coast Exhibition, you write:—"But when one arc lamp gives out a superior light to others, the chances are that it is consuming proportionately more horse-power." I think this is calculated to give the public an impression that our light does consume proportionately more horse-power; and as, on the contrary, our system has the advantage of giving a greater candle-power in proportion to the horse-power employed, I shall be very much obliged if you will let this appear in your next publication.

I am, dear Sirs,
Yours faithfully,
C. H. CHARLEWOOD,
Secretary.

121, Bishopsgate Street Within, London,
Sept. 27th, 1882.

[We insert Mr. Charlewood's letter with pleasure. What we intended to convey in our remarks was that if a given current strength is passed through the carbons of electric lamps, the same light-power may be obtained in various lamps, provided that the carbons employed are of the same kind, and the resistance of the coils in the lamps are alike.—EDS. ELEC. REV.]

NEW DYNAMO-ELECTRIC MACHINES.

To the Editors of THE ELECTRICAL REVIEW.

DEAR SIRS,—In reference to your remark in your last issue with regard to the efficiency of the Ferranti machine, I take the liberty of drawing your attention to the following extract from an article in the *Engineer* of Saturday last. I take the opportunity of explaining that in speaking of the Ferranti machine as five times as efficient as any other dynamo machine, I had reference to the first standard, and not the second.—Yours truly,

ROBT. HAMMOND.

110, Cannon Street, London, E.C., *Sept. 27th*, 1882.

[EXTRACT.]

"There are two distinct primary standards by which the efficiency of a dynamo can be measured, and we would impress on our readers the necessity of keeping these standards carefully apart. According to the first the efficiency of the dynamo is determined by its small size, low first cost, and excellence of construction in the matter of workmanship. According to the second, its efficiency is measured by the proportion which the power given out bears to that put in."

ROBBERY OF TELEGRAPH MATERIAL.—The foreman to Messrs. Fitzmaurice & Co., the Birmingham contractors for keeping the underground telegraph wires in order, and an assistant were, at Birmingham this week, charged with stealing a quantity of telegraph wire belonging to the Post-office authorities. It was stated that owing to the robbery all communication with the North was suspended for upwards of two hours, and a great number of wires could not be completely rectified for two days. The men were engaged in connection with a number of wires running in one direction when they came upon several running across, and pulled them up with the assistance of two horses. The sudden interruption at the telegraph offices caused the authorities to think some very serious accident had occurred. It was eventually found that the prisoners had sold the wire to a marine store dealer. One of the wires which the men broke and sold was rented as a private wire by a London and Manchester firm of cotton brokers. The Stipendiary Magistrate committed the prisoners for trial.

ELECTRO-MOTORS.

LAST week, when describing the "Griscom" electro-motor, we challenged the accuracy of the inventor's statement concerning the effect of the currents induced in the wire with which the ring of the motor is coiled, by the action of the revolving armature. Our assertion that the induced current is in opposition to the battery current has had the effect of bringing us into direct communication with Mr. Heap, the representative of Mr. Griscom's invention in this country. The gentleman referred to maintains that the induced current strengthens the battery current, and, in the endeavour to prove his views, he has very courteously

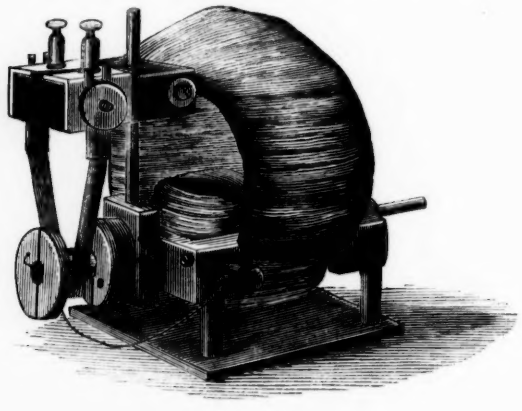


FIG. 1.

allowed us to make use of a model motor, constructed specially to show the effect of "double induction." A general view of the apparatus is shown in fig. 1, and a diagram is given in fig. 2. The motor consists of an ordinary Siemens armature, A, revolving between the ends of a soft iron horse-shoe, I. This latter is coiled with wire, W, and

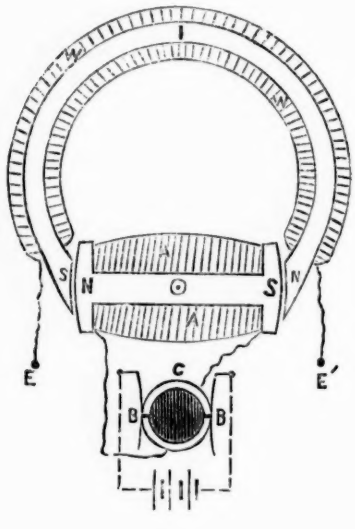


FIG. 2.

the ends, E, E', may be left free or they may be connected together, forming a closed circuit round the horse-shoe. The commutator, C, is of the ordinary construction, and the rubbers, B, B, are made in the form of the "Gramme" brushes. These may be adjusted at any point on the commutator, being movable on a centre, as can be seen in fig. 1. This model motor will revolve in either direction by shifting the brushes more to the left or to the right. If a battery be connected to the brushes, as shown in the diagram, and the armature magnetised, attraction immediately ensues between the poles and the ends of the soft iron horse-shoe—the ends, E, E', of the coil, W, being left quite free—and the armature begins rapidly to revolve. Now if the ends, E, E', be joined together, forming a closed circuit round the horse-shoe, the armature increases its pace in a great degree.

Mr. Heap holds that this model, although different in construction, is identical in principle to the present form of the Griscom electro-motor, and that the extra speed given to the armature on closing the circuit of the coil, W, proves that the induced current adds to the power of the battery current.

It will be observed that the battery is not attached in any way to the coil surrounding the soft iron. By means of the diagram, fig. 3, we hope to be able to place before Mr. Heap an exact representation of what occurs in the foregoing model when the coil around the soft iron is open or closed. We will suppose N, S, to be two magnetic poles, an equivalent in fact of the Siemens armature; I, again, represents the soft iron horse-shoe straightened out, and W is the coil surrounding it. Now if we pass before the ends of the soft iron the poles,

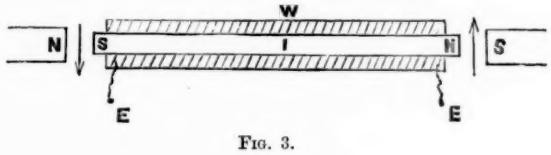


FIG. 3.

N, S, in the direction of the arrows we shall meet with a certain resistance to motion owing to the magnetic attraction set up between the masses. As long as the two ends of the coil, E, E', are kept apart we may regard I in the light of soft iron only; but directly they are joined we must look upon it from another point of view. It now becomes magnetically acted upon from two different sources; magnetism due to the inductive action of a magnet in its vicinity, and magnetism induced from the current set up in the closed circuit of the coil, W. This induced current tends to magnetise the iron in an *opposite* direction to that due to the induction of the magnet, the resultant magnetism being, therefore, weaker than in the first case, when the coil, W, is open. It is, therefore, easy to understand that the resistance to motion will now be less, and therefore the same amount of energy developed by the battery will drive the armature round at a faster speed. It should be recollected that increased velocity does not necessarily mean increase of power. According to the

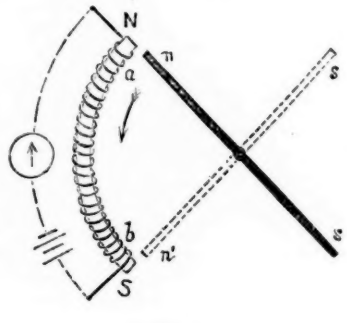


FIG. 4.

Griscom theory we might argue that the power required to move a railway train at a velocity of twenty miles an hour with the brakes off is greater than that necessary to propel it at a speed of ten miles an hour with the brakes hard on, simply because the velocity in the one case is greater than that in the other. We think that this explanation will make it sufficiently clear to show where Mr. Heap is in error, and in order to still further maintain our statements of last week we will return to the subject of the Griscom motor proper.

We will consider what takes place in this electro-motor by regarding the coiled portion of the ring as a segment of a "Gramme" ring, the ring being stationary and the field magnet rotating. The current in the ring-wire will then be continuous as long as the wire remains under the action of

the field magnet. In this question we have nothing to do with the magnetism of the ring, but only with the magnetism of the field magnet acting upon the coiled segment of the ring, in which it produces, as we have said before, a current in a contrary direction to the battery current.

Take a helix, *a*, *b* (fig. 4), surrounding a segment of iron and pivot in front of it the magnet *n*, *s*. Now, if a battery and galvanometer be put in circuit, it will be found that the magnet, *n*, *s*, will be deflected to *n'*, *s'*, the galvanometer at the same time showing a deflection. Then remove the battery (fig. 5), and move by hand the magnet, *n*, *s*, into the position, *n'*, *s'*, and a deflection on the galvanometer in the *opposite* direction to that due to the battery in the previous experiment will be observed, and not in the same direction. The magnet represents the magnetised rotating armature, and the helix the stationary coil in Griscom's motor. With these two different explanations of the action of the American inventor's apparatus, we think that sufficient proof has been put forward that the induced current is in the reverse direction to that produced by the battery. Indeed, could

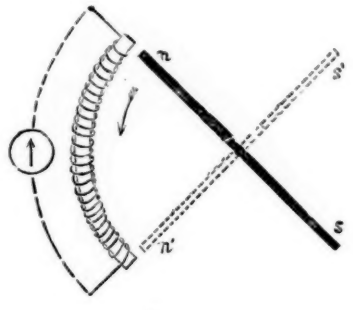


FIG. 5.

Mr. Griscom support his theory, he would have made a promising step in the direction of the much-coveted *perpetuum mobile*.

However we have seen this little instrument performing various operations, and it appears to be a highly satisfactory apparatus for many purposes. For sewing machines it is especially to be recommended, and we have seen a double thickness of cloth very rapidly sewn together, the current being produced by a battery similar to that we described last week and containing six elements. When we called upon Mr. Heap, this battery had already been in action about five weeks, and he informs us that sewing machines might be used for the ordinary work of a private house every day for two months or so, without any necessity arising for recharging the battery. Two of these motors with their axles joined together, and connected electrically in multiple arc, are calculated to produce the power of one man, when actuated by the battery just alluded to. We think that such an admirable domestic help as the Griscom motor would command ready appreciation were its performances made more publicly manifest.

NOTES.

ERRATUM.—In our article on the Jürgensen dynamo-electric machine and lamp last week, p. 239, for "21 lights of 2,000 candle-power," read, "4 lights of 2,000 candle-power."

NEW DYNAMO-ELECTRIC MACHINES.—We have been informed that 40 arc lamps (candle-power not stated) have been kept alight from the new Ferranti-Thomson machine, all being connected in multiple arc. We also further understand that the patents of the two inventors include both alternating and continuous current machines, based on the same principle.

THE MAXIM-WESTON ELECTRIC LIGHT COMPANY.—Mr. Frank Howard Landon writes to us to the effect that he has resigned the secretaryship of the above company.

THE ELECTRIC LIGHT ON THE S.S. "INVICTA."—It may interest our readers to know that the fitting up of the lights on board the *Invicta*, which has been referred to in various papers as being very successful, was entirely carried out by Messrs Siemens Brothers; although, up to the present, we believe, the name of that well-known firm has not been mentioned in connection with the installation. We understand that Messrs. Siemens have lately obtained the contract for fitting out the s.s. *Arizona* of the Guion Line, entirely with the electric light.

ELECTRIC LIGHTING.—A special meeting of the Manchester city council has been called for Wednesday, October 25th, for the purpose of adopting, if the council shall think fit, a resolution or resolutions, authorising and directing an application to the Board of Trade for a provisional order, empowering the Corporation to supply electricity for public and private purposes, within an area co-extensive with the city of Manchester, and authorising the Town Clerk to take all steps prescribed by law for the promotion of such application.

A VERY successful experiment was made last week with the electric light at Grandholm, near Aberdeen. The new dye house, a building 170 ft. by 40 ft., was well lighted by three Fyfe-Main lamps. Two large steam pipes from the engine house boiler were used to fill the building with steam to its utmost capacity. No appreciable difference was noticed either in the illumination or the steadiness of the light. Samples of woollen materials of a variety of colours and shades were compared, and they could be distinguished as well as in daylight.

A SPECIAL meeting of the Sheffield Town Council was held on Wednesday week, to consider what action they should take under the Electric Lighting Act. Six electric lighting companies in London and elsewhere had given notice to the Council of their intention to apply for a provisional order, and it was the wish of a very large majority of the Council that they should be prevented from coming to the town. After a long discussion, it was decided that it was desirable that the Council should apply to the Board of Trade for a provisional order, and a committee was appointed to take the necessary steps to obtain it.

WE understand that at a meeting of the Glasgow Gas Committee on the 20th inst., the position of the city with reference to several electric light companies was duly considered. It was unanimously resolved to recommend the Council to apply for a provisional order enabling the Corporation to light the streets by means of electricity should such a step be considered desirable.

THE Maxwelltown Town Council has transmitted the electric light companies' applications to the Clerk of Commissioners of Police for consideration.

A STATISTICIAN says there are already thirty electric light companies in England, with a capital of over £6,000,000. The number in France is less, but the capital is nearly as great. There are over fifty companies in America, and the capital is considerably over £10,000,000. The average dividend is not given.

AT the periodic meeting of the Edinburgh Town Council, on Tuesday, notice was given of the following motion:—"That in view of the numerous intimations by speculative companies of intentions of applying to the Board of Trade and to Parliament for authority to introduce the electric light into the city it be remitted to the Lord Provost's committee to consider whether the council does not already itself possess that power; and if it does not, whether any supplementary powers necessary should not be sought under the Electric Lighting Act of the present session of Parliament."

THE Railway Electric Appliances Company have made the following proposal to the Glasgow Town Council:—"That the City of Glasgow should go to the expense of erecting electric lamp standards in each of the four large plots in George Square, as well as running the necessary copper leads for lighting the lamps. The Appliances Company then undertaking to put their lamps up for a certain time, receiving payment or not at the option of the Corporation. The advantages of this system would be that the Corporation would have the power of viewing the various

methods tested at very little expense; that they could say to each company desiring to compete for the city lighting: 'Here are our four standards, put your lights up and run them for a month free.' After the Corporation had tried several of the most improved systems they would then be in a position, having the prices and terms before them, to decide which to adopt." This communication and the general question of lighting the streets by electricity were remitted to a committee for consideration.

THE Swan, Edison, Crompton, and other companies, have given notice of their intention to apply to the Board of Trade for Provisional Orders to supply Glasgow with electricity.

IN a section of the London Underground Railway it is proposed to fix, experimentally, some 200 Swan incandescent lamps, so as to do away with the artificial lighting of the carriages.

ELECTRIC LIGHTING STANDARDS.—The following letter, which appeared in the *Times*, refers to the respective merits of two differents systems of electric lighting:—

1, Great Winchester Street Buildings, *Sept. 26th.*

Sir,—My attention has been drawn to a statement in the advertised prospectus of the Lancashire Maxim-Weston Electric Lighting Company (Limited), on the authority of Mr. W. Sugg, of gas-burner celebrity, that the "Jablochkoff light" is equal to 114 candle-power as compared to a much larger illuminating power said to be given by the "Weston and other arc" lamps. The Jablochkoff light has been tested by the scientific staff of the Metropolitan Board of Works in connection with the lighting of the Victoria Embankment. The experiments extended over ten days, and the average lighting power of the lamps there was proved to be equal to 378 candles, and as such reported to the Metropolitan Board of Works.

As the statement made in the prospectus above referred to is calculated to seriously prejudice this company, I beg you will allow me to make this correction, and at the same time to state that although we have adopted this as our standard, the Jablochkoff light is capable of a much greater illuminating power by using larger candles.

I am, Sir, yours truly,
FRA. B. REEVES, Secretary of the Jablochkoff Electric Light and Power Company (Limited).

We do not think that the Jablochkoff Company will suffer by such remarks as those of Mr. Sugg, who does *not* state what *extra* horse-power is taken up in the Weston Arc Lamp to account for its superior light.

ELECTRIC LIGHTING IN THE CITY.—At the meeting of the City Commissioners of Sewers this week a report was submitted by Mr. Baylis, giving an analysis of the provisions of the Electric Lighting Act, 1882. The Clerk laid before the Court notices under the Electric Lighting Act from the Edison, Metropolitan Brush, Pilsen-Joel and General, Swan United, and Gülcher Electric Light Companies, and Messrs. Ferranti, Thompson, and Ince, of their intention to apply to the Board of Trade for provisional orders to supply electricity within the City. The notices were referred to the Streets Committee.

THE UNIVERSAL ELECTRIC COMPANY (LIMITED).—The following report of Professor S. Thompson will probably interest our readers, but we can scarcely understand the apparently low efficiency of the lamps, both arc and incandescent:—

GENTLEMEN,—I have the honour of presenting you with a preliminary report upon the machines and appliances of the Universal Electric Company (Limited). I have devoted two days to examining and testing the same, with very satisfactory results.

The machines and instruments that have been examined by me are of five kinds:—

1. The Akester Dynamo-electric Generator.
2. The Akester Arc Lamp.
3. The Akester Incandescent Lamp.
4. The Akester Motor.
5. The Mercurial Exhausting Pump for procuring the vacuum in the lamps.

The Akester Dynamo is of great excellence. As an electrical generator its efficiency is very high, as is witnessed both by careful tests and by the fact that the armature-coils are not sensibly heated after running for several hours continuously. It is extremely simple and workmanlike, both in design and construction, and has the great advantage of requiring little skilled labour in its manufacture. Its electromotive force, while ample both for arc lights and incandescent lamps, is below 100 volts even when running at its highest speed; and it is, therefore, impossible for any danger to ensue from any person touching any part of the machine.

The Akester Arc Lamp is of an entirely novel construction. The regulating mechanism, usually so complicated and expensive in lamps of this class, is extremely simple, and at the same time serves efficiently the function of regulating the arc and feeding the carbon as fast as consumed. The arc lights examined by me possessed a brilliancy exceeding 500 candles per electrical horse-power.

The Akester Incandescent Lamp is well made, and stands satisfactorily the tests I have applied as to its illuminating power. The lamp nominally of 12½ candle-power gave an actual light of 21 candles, with a current of 1½ ampères.

The Mercurial Exhausting Pumps employed on the Works are cheap and practical in every way.

The Akester Electric Motor having a power of about 1-10th of a horse-power runs extremely well, and is a handy and portable motor. It is superior to the motors of Griscom, Trouvé, and others, in having no dead points. It would be extremely useful for driving lathes or other light machinery.

Your works appear to be most admirably suited for the purpose of an electric manufacturing establishment, and I cannot speak too highly of the attention and kindness of Mr. Akester and his subordinates in affording me every kind of facility for making the tests and for examining the work in hand.

I am, Gentlemen,
Your obedient servant,
SILVANUS P. THOMPSON.

4, Baltic Street, Glasgow, *September 26th*, 1882.

We hear that this company has already received sufficient orders to keep it supplied with work for a considerable time.

RAILWAY AND ELECTRIC APPLIANCES COMPANY.—His Grace the Duke of Manchester, K.P. (chairman of the Railway and Electric Appliances Company, Limited), visited Glasgow last week, for the purpose of inspecting the works of the company at Polmadie, as also the extensions now being erected there. His Grace was accompanied by the Hon. the Lord Provost, and a number of other gentlemen. They were conducted over the works by the manager, and the various electrical appliances were fully explained and demonstrated by the inventor (Mr. Rankine Kennedy). The Maxim lamp was exhibited, over 100 of them being lighted by a small Kennedy dynamo machine. Four Kennedy arc lamps of 2,000 candle-power were also exhibited, supplied by a similar machine. The great power and steadiness of these lamps were admired, and his grace expressed himself as highly satisfied with all he had seen. The company, it may be added, has at present a considerable number of orders on hand to light private mansions.

We extract some correspondence from the columns of the *Daily Mail* concerning the operations of this company:—

In reply to a "Shareholder's" question in his letter appearing in this morning's *Mail*, you will perhaps allow me to explain that the dynamo machines and electric arc lamps which were exhibited at the Crystal Palace, and obtained the silver medal there, and from which such splendid results were obtained on Wednesday last, were constructed according to my patent, obtained by me in the beginning of October, 1881. Mr. Akester applied for a patent for a dynamo-electric machine in the end of December, 1881, after having easy access to our works for two months, during which we were manufacturing machines according to my October patents. For obvious reasons I lodged an opposition to the granting of his petition for a patent, and on the case coming before the Attorney-General, he did not "declare that the patent was Mr. Akester's," but merely gave Mr. Akester permission to apply for the sealing of his patent; and if Mr. Akester should apply for the seal, I can have the case heard in open court, and witnesses produced on oath to show reason why the seal should not be granted for the patent which he applied for in December last. The dynamo-electric machine involved in the opposition is the dynamo-electric machine for which Mr. Akester applied for a patent in December. The opposition had nothing to do with my patent, which was obtained in October, three months before Mr. Akester's application. This explanation will clear up some of the mistakes into which "Shareholder" has fallen. I can take no further notice of anonymous letters.—I am, &c.,

Glasgow, *Sept. 23rd.* RANKIN KENNEDY.

In sympathy with your correspondents, "Lynx" and "Fly-catcher," I should like to get some information about this company. From a paragraph which appeared in the ELECTRICAL REVIEW of Saturday, the 16th inst., it appears that from the statutory return made by the proper official of the company, and filed on the 22nd ult., "the nominal capital of the company is £500,000, in £1 shares. Upon 91,668 shares 12s. 6d. has been called up, and 12,000 shares have been issued as fully paid-up. The total amount of calls paid is £33,144 4s., which includes £1,499 paid in advance of calls due on August 25th. The total amount of calls unpaid is £24,148 6s." From the prospectus of the company it appears that the vendors, viz., "The Williams Railway Patents Company (Limited)," and "The National Electric Company (Limited)," were to receive £95,000 in cash and paid-up shares. Perhaps Messrs. Smith and Arrol, who were directors of both companies, will inform the shareholders whether the enormous sum has been paid, and if so, for what? It would be well that a statement full and clear were given, and particularly to whom the 12,000 paid-up shares were given, and for what? There is quite sufficient in the public records to afford information for making a precise analysis of this company and the work it has done for the last six months.—I am, &c.,

Glasgow, *26th Sept.* ANOTHER SHAREHOLDER.

Fire Risks from Electric Lighting.—Mr. Heaphy, C.E., in a letter to the *Times*, adds still further to the rules and regulations recently framed by him for the guidance of the Phœnix Fire Office, but these additions are addressed more directly to the occupiers and owners of private dwellings.

Rule 1.—See that no naked wires are used. Try and arrange that they be covered with a material rendered as incombustible as possible. This you can very easily test for yourself.

Rule 2.—See that all wires are kept at least one inch apart from each other (if they are "leads" two inches), and one inch from all metallic substances.

Rule 3.—See that no wire hangs loosely, and that they are in such a position as not to be liable to derangement or injury from external causes. Get them enclosed, if possible, in wood or slate beading having a continuous fillet to keep the wires separate.

Rule 4.—See that none of the fastenings of the wires are composed of metal.

Rule 5.—Have a "cut out" for every room, and if possible for every light. A "cut out" is a short piece of easily fusible metal, such as lead, inserted in the wire conveying the electricity to the light or lights.

Rule 6.—See that your wires—unless they have a waterproof covering—are kept free from wet.

Mr. Heaphy continues:—"This last rule is more important than it seems, for paradoxical as it may appear to those not versed in the subject, water can easily bring about a fire through its property of conducting electricity, several cases of wood being charred having already arisen, and a fire in America has occurred from this cause.

"The above rules apply to incandescent lighting only, as in every case of arc or semi-incandescent installations an inspection will probably be made by the Fire Office insuring the building.

"In order to prevent any unnecessary alarm in the mind of the public, I may state that all my experience so far has not caused me to alter in any way the opinion contained in my report, viz:—'That where systematic and proper precautions are taken there is less danger from electric lighting than from gas; but that if carelessly or ignorantly arranged or improperly worked then serious fires may be apprehended.' Unfortunately the demand for competent men to lay the wires is already exceeding the supply.

"It is only fair to state that the care taken to prevent fires by one or two of the electrical companies deserves much praise. I regret having to withhold their names, as I do not wish the accusation brought against me of giving undue prominence to any of them."

Completion of a New Atlantic Cable.—We observe in the *Standard* of the 28th inst. a note with the above heading, which appears to us slightly confused. The *Times* has precisely the same note, but headed "Atlantic Telegraphy." "Among the passengers arriving at Plymouth yesterday by the Royal Mail steamer, *Nile*, were forty-two of the staff of the Silvertown Cable Company, from Panama. They comprised electricians, engineers, &c., and were returning to London upon the completion of the new cable which has been laid from England to Panama. The time occupied in the work has been remarkably brief; but a year elapsed from the commencement to the termination, as not a single serious hitch occurred during this period. The steamers engaged have been the *Dacca* (?), the *Silvertown*, and the *Retriever*. The remainder of the staff of 118 persons were at Panama, under the direction of the chief electrician, Mr. Thomas Grey. Mr. Matthew Grey, the second electrician, reached Plymouth yesterday, and proceeded with his coworkers in the *Nile* to Southampton."

The Panama Earthquakes.—A *New York Herald* telegram, dated Panama, September 8th, says:—"Mr. Robert Gray, F.R.G.S., the chief of the India-Rubber and Telegraph Works, of Silvertown, with Mr. Joseph Stearns, Central and South American Telegraph Company, report an earthquake in the Bay of Panama some six weeks ago. It was felt on the *Silvertown* cable ship. Mr. Gray also reports another up the coast, likewise felt on board, following it.

"The West India and Panama cable is reported broken."

Telephone Extension.—By an arrangement with the Post-office authorities, several subscribers to the National Telephone Company's Aberdeen Exchange will shortly enjoy the privilege of communicating direct with the Post-office in that city.

Telephonic Communication with Divers.—Mr. Wake, engineer of the River Wear Commissioners, and Mr. Irish, Manager of the Northern District Telephone Company, have recently been engaged in a series of experiments with a telephone arrangement specially devised by the latter for conversing with a diver in his dress when engaged in submarine work. On the 15th instant, Mr. Stone, a diver, descended in his dress to the bottom of the dock, where he successfully carried on an animated conversation with persons on *terra firma*, asking at various times for implements used in diving operations to be sent down to him, and putting questions to the persons on land. These experiments having proved so successful, it was thought advisable to exemplify the same at the North-East Coast Exhibition at Tynemouth, and on Thursday, the 21st, the telephone was severely tested by Mr. Lambert, of the firm of Siebe and Gorman, submarine engineers, who descended on three occasions during the afternoon into the diving tank, and placed himself in all the positions that a diver has to assume in order to carry out his work. The length of cable used in these experiments, through which the conversations were carried on, was 600 yards.

The Scottish Telephone Case.—We hear that Mr. Maclean, the defendant in the recent telephone trial in Edinburgh, has been declared a bankrupt at the instance of the United Telephone Company.

Post-office Telegraphs.—The competition of young girls to obtain appointments in the Post-office telegraphs is rather increasing than abating. An examination was held on Wednesday last, at which there were no less than 800 candidates for 30 appointments. The salary is very small, commencing at 10s. per week only.

Telegraphing without Wires.—A friend has brought before our notice a book entitled "Electricity and the Electric Telegraph," published in 1852, and written by George Wilson, F.R.S.E., who, in speaking of schemes for telegraphing across the Atlantic and the Pacific, says:—"One of these, whether hopeless or not for immense distances, is so very ingenious and so likely to succeed across limited spaces, that we cannot pass it unnoticed. It dispenses, except to a very trifling extent, with wires, and carries the current *both ways* through moist earth and water. It is desirable, for example, to telegraph from the right to the left bank of a broad river. From the copper end of a battery on the right bank a wire is carried to the shore (on the same side) and soldered to a plate buried in the river below water-mark. A wire is also led from the zinc end to a long coil of wire which ends in a metallic plate. This likewise is buried in the river below water-mark on the same right bank, but at a distance from the battery *considerably greater* than the breadth of the river across which signals are to be sent. On the left bank two plates are immersed opposite those on the right bank, and connected by a wire.

"The electricity on leaving the battery has, therefore, the choice of two paths. It may either keep entirely on the right bank, passing from the one buried plate on that side to the other, and so back to the battery by the long coiled wire; or it may cross to the left bank through the water, traverse the wire on that side, return across the water to the right bank, and regain the battery by the shorter wire. The Thames has been actually crossed by electric currents in this way; the resistance to their passage by the water between the banks being less than that between the ends of the wires on the right and left bank respectively."

Lightning Conductors.—As an outcome of the recent instructions issued by the Home Office for the examination of lightning conductors, the city superintendent of Edinburgh has applied to this Town Council for authority to obtain apparatus and to employ professional assistance in inspecting lightning conductors.

TENDERS INVITED.—The Post-office authorities invite tenders for red fir telegraph poles, and for creosoting the same. The poles to be delivered in lots at the Northumberland Dock, Tyne or West Hartlepool, Perth, and Dublin. Forms of tender, containing all particulars, may be obtained on application to Mr. W. H. Winter, Controller of Stores, Telegraph Street, London.

IMPROVEMENTS IN ACCUMULATORS.—We have received another letter on the above subject from M. Blanchart, which however we cannot insert, as we closed our discussion with him last week. He charges us with employing derisive, instead of serious, arguments; and concludes by saying that the real cause of our exchange of correspondence was an erroneous interpretation of the figures which he gave. We thank M. Blanchart for the courteous manner in which he has met our remarks, and we cannot bring the matter to a close without expressing a wish that we may again be favoured with our correspondent's views on other things electrical.

HYDRO-DYNAMIC EXPERIMENTS; IMITATING BY LIQUID OR GASEOUS CURRENTS THE STRATIFICATIONS BY ELECTRIC LIGHT IN RAREFIED GASES AND THE VARIOUS FORMS OF THE ELECTRIC SPARK.—By M. C. Decharme.—To imitate by the hydrodynamic method the stratifications of the electric light in rarefied gases, I employ a procedure analogous to that which I made use of in imitating the magnetic shadow by an electric current in a plane parallel to its direction; that is, above the plate covered with a stratum of red lead there is transported horizontally and rapidly a tube of greater or less width, whilst water flows from it, or whilst air is blown through it. The current is thus projected and is spread out in a straight or curved line over the pulverulent deposit. The traces which it there produces are often preserved with their delicate forms. For certain effects a current of air may be advantageously substituted for one of water. By varying the experimental conditions we find among the designs obtained forms analogous to those of the stratifications of the electric light in gases rarefied to different degrees.

As for the numerous effects produced by the two methods of experimentation, I content myself with pointing out the principal results relative to hydrodynamic imitations; the corresponding phenomena among electric effects will be easily recognised.

The strata are the more apparent as the stratum of red lead is thinner, still beyond a certain limit the effects disappear. The strata are the more numerous and close together as the furrow produced is narrower, or, in other words, as the tube employed is narrower. They are generally in arcs of circles or in broad bands, sometimes in the form of a V, like those which Mr. Warren de la Rue has shown in his fine researches on the electric discharge.

It is frequently found in separate drops analogous to the globular strata given by the electric discharge through a tube containing carbonic acid at the pressure of 0·5 millimetres.

The multiple and relatively very large circles which surround the origin of projection of our figures are not without analogy with the aureolar or rather globular, forms which the electric light assumes at the positive pole, whilst at the negative pole there is a simple tuft. In like manner at the other end of the pulverulent furrow there appears a kind of tuft, like a flame.

Our hydrodynamic imitations of the stratifications of the electric light show all the degrees of the phenomenon, from the plain, unstratified current, to the current with drops visibly separate and passing through all the intermediate forms.

The author's memoir comprises further the hydrodynamic imitation of the different forms of the electric spark, of the figures of Lichtenberg, and of the projection effects of a metallic wire volatilised by the electric discharge.—*Comptes Rendus.*

ON THE FORMATION OF SECONDARY ELEMENTS OF LEAD PLATES.—By M. G. Planté.—The operation which I have designated under the term *formation* of secondary elements consists in a preliminary electro-chemical preparation of these elements with the object of deeply oxidising one of the electrodes and reducing the other to a state of metallic division, which enables the chemical actions to exert themselves more completely during the charge and the discharge, and to accumulate, in consequence, a greater quantity of the chemical work of a primary current. I have sought to perfect this operation. When studying the chemical actions produced in these couples, I have observed at first the transformation of one part of the peroxide of lead into a sulphate of the same metal under the action of the water, acidulated with sulphuric acid, in which the elements are plunged, a result which has been recently confirmed by Messrs. Gladstone and Tribe, in an interesting investigation on this subject. I have sought to increase the capacity of accumulators by producing a galvanic deposit of lead upon the electrodes, so as to make the oxidising action of the primary current penetrate more deeply by reason of the exceptional porosity of the electro-chemical deposits. To this end the most varied combinations were tried, and the majority of the compounds of lead, soluble and insoluble, without obtaining deposits sufficiently coherent and adhesive, and whose electric contact with the electrodes could remain indefinitely secure. I finally reached the conclusion that the best method was to endeavour to transform the metal itself of the electrodes almost in its whole thickness into galvanic peroxide of lead on the one hand, and of reduced lead on the other. I arrived at this result by a series of changes in the direction of the primary current with intervals of rest between.

To give an idea of the effects obtained by this method, I will add that with a secondary element already partially formed, the lead of which weighed 1½ kilo., the current of discharge which yielded at first a deposit of copper of 7 grms. in a voltameter gave, after a new change of direction, a deposit of 11 grms., then after an interval of rest and another change of direction a deposit of 18 grms., and 12 grms. per kilo. of the secondary element, which corresponds to more than 36,000 coulombs.

This is not, however, the limit which can be obtained, for a new change of direction determines a new increase in the quantity of chemical work accumulated, and so on. There is no other limit than the thickness of the lead plates. Admitting that we only seek to transform half the thickness of the metal, preserving the other half as the body of each electrode, and even that the peroxide is only reduced to protoxide at each discharge, we may hope to obtain by this method a discharge current sufficient to deposit about 74 grms. copper per kilo. of the lead of the secondary element, which represents a very considerable quantity of electricity.

This system of changes of alternate directions has not merely the effect of augmenting successively the layer of peroxide of lead formed at the expense of the metal of one of the electrodes, but also of transforming to a corresponding depth the other electrode into lead galvanically reduced, so that whilst the hydrogen derived from the decomposition of water in the interior of the element reduces the peroxide of lead formed by the primary current the oxygen may oxidise at the same time an equivalent quantity of metallic lead.

We may explain the efficacy of the intervals of rest between each change of direction by considering that after a certain time the plates of lead thus modified become less good conductors at their surface. Hence it results that on submitting them again to the action of the primary current it follows naturally in traversing the liquid the path of least resistance. It does not pass directly by the oxidised surface, but by the subjacent metallic surface to which the liquid penetrates. It thus oxidises by the mere fact of its passage a new layer of metal and it peroxidises also by degrees the exterior surface which has been already oxidised, or it effects the inverse work of reduction if the direction of the current has been changed.

Thus a kind of galvanic cementation is effected, in consequence of which the two plates of lead are profoundly modified in their structure; for the one is then found to be partially formed of crystalline and brilliant peroxide of lead, and the other of reduced lead, with an appearance equally crystalline. When a secondary element is in these conditions it preserves its charge well enough to give, after four months, luminous and thermic effects.

This method certainly requires a long time, especially at the commencement. To facilitate the attack of the lead by the electro-chemical action of the primary current, I have observed that the *formation* of the secondary elements is accelerated by raising the temperature of the liquid in which they are immersed either beforehand or during the action of the current. But as this use of heat presents some difficulties in practice I have had recourse to another process, which gives very satisfactory results.

This process consists in submitting the secondary elements to a sort of thorough cleansing with nitric acid mixed with half its volume of water, leaving them immersed in this liquid for twenty-four or forty-eight hours. The elements are then drained, washed very thoroughly, filled with water acidulated with 10 per cent. of sulphuric acid, and submitted to the action of the primary current. By this immersion in dilute nitric acid a portion of the lead is doubtless dissolved, but the thickness of the plates is not notably diminished, and in consequence of the metallic porosity the chemical action is not confined to the surface of the lead plates ; it is also exerted in the interior, it creates fresh molecular intervals, and it consequently facilitates the ulterior penetration of the action of the primary current.

The secondary couples thus treated can yield in a week, after two or three changes of the direction of the primary current discharges of long duration, whilst without the previous action of nitric acid they would only give the same results after several months. This process will, therefore, notably abridge the *formation* of secondary elements, and will contribute to facilitate their application.—*Comptes Rendus.* (*See* ELECTRICAL REVIEW, September 9th.)

THEORETICAL AND PRACTICAL CONSIDERATIONS ON THE PHENOMENA OF ELECTRO-MAGNETIC INDUCTION. APPLICATION TO THE ORDINARY TYPES OF MACHINES.—By M. G. Le Goarant de Tromelin.—In the first part of my memoir I establish the formulæ of the intensity and the electromotive force of the machines. I find thus, for the Siemens type—

$$(1) \qquad e = \frac{2\text{HLK} \cos a\, v}{g^2}$$

and for the Gramme type,

$$(2) \qquad e = \frac{\text{LK} \cos a}{g^2} (\text{H}\, v - \text{H}'\, v')$$

In these formulæ e is the electromotive force, H the intensity of the magnetic field traversed by the wires in the Siemens machine, or of the outer wires in the Gramme system, and H' the intensity of the field traversed by the interior wires of the ring in the Gramme ; K the half section of the wires of a plane perpendicular to the axis of rotation ; L the length of one of the parts of a spiral parallel to the generator of the cylinder or of the ring ; v the linear speed of the outer wires, v' that of the interior wires ; g^2 the section of the wires submitted to induction and $\cos a$ a mean co-efficient depending on the number of sections of the coating and their position with reference to the lines of force.

On refixing the keeper of soft iron in the coating, I find by a new method in Siemens—

$$(3) \qquad e'' = \frac{2\text{H,LK} \cos a\, v,}{g^2}$$

and in Gramme—

$$(4) \qquad e'' = \frac{\text{LK} \cos a}{g^2} (\text{H}\, v + \text{H}_1\, v').$$

On adding (1) & (3) and (2) & (4), we obtain the total electromotive forces in Siemens.

$$(5) \qquad \text{E} = \frac{2\text{HLK} \cos a\, v}{g^2} \text{H} + \text{H}_1,$$

in Gramme—

$$(6) \qquad \text{E} = \frac{\text{LK} \cos a\, v}{g^2} (\text{H} + \text{H}_1) - \frac{\text{LK} \cos a\, v^1}{g^2} (\text{H} - \text{H}_1).$$

The formulæ (5) and (6) show that the iron keeper in the coating acts merely by reinforcing the magnetic field, so that the current produced would have the same intensity if the iron was fixed, as if the speed possessed of the total arrangement were given to the induced wires alone.

The formulæ show that in the Gramme machine the keeper does not act like a screen preventing the induction from being produced in the interior wires of the ring, but that of the electromotor force which its presence develops, it annihilates in part the inverse electromotive force which is produced in the interior wires.

The first term of the second portion of the formula (6), represents the electromotive force due to the outer wires ; the second portion that which is due to the inner wires. The resulting current is the difference between the two currents, proportional to the field traversed and the linear velocity possessed by the induced wires.

The total magnetic field being influenced by the current which circulates in the coating, the reaction produced upon the field must be taken into account.

I then calculate the new values taken by the electromotive force and the intensity when, in a generator of electricity of which we suppose the inducing field as constant, we replace the existing induced coil by another, alike in form and size, but wrapped with wire of a different thickness or of different size but geometrically similar to the former.

I show, then, that with a generator moved by steam, E may be obtained constant, whilst I varies inversely as the total resistance if the machine is fitted with a speed regulator, or otherwise we may obtain I constant and independent of external resistance, but E varying proportionally to that resistance if the steam-engine works with its valve wide open, on condition that we suppose the mean power transmitted constant and the magnetic fields saturated or constant.

The general theory of these machines devolves naturally from these considerations.

I conclude by the study of the tangential efforts and of the work to be overcome resulting from the electro-dynamic reactions produced in the generators of electricity.

A part of these latter propositions has been already discovered by M. M. Deprez, who has taken another point of departure, considering thereby the action of currents upon currents.—*Comptes Rendus.* (Author's abstract.)

OFFICIAL RETURNS OF ELECTRIC LIGHT COMPANIES.

LAING ELECTRIC LIGHT AND POWER COMPANY (LIMITED).—The return of this company, made up to May 17th, was filed on May 23rd. The nominal capital is £1,000,000, in £10 shares, but the only shares recorded as taken up are the seven subscribed for by the signatories to the memorandum and articles of association.

DOMESTIC ELECTRIC LIGHTING COMPANY (LIMITED).—The return of this company, made up to May 18th, was filed on May 31st. The nominal capital is £50,000, divided in 49,000 A shares and 1,000 B shares of £1 each. At the time of making up 7 A and 100 B shares had been allotted, but no call had been made.

HAMMOND ELECTRIC LIGHT AND POWER SUPPLY COMPANY (LIMITED).—The return of this company, made up to June 1st, was filed June 12th. The nominal capital is £250,000, in £5 shares. Upon 17,980 shares £2 10s. per share has been called, and the full amount upon 7,020 shares. The total amount of the calls paid is £80,050.

GULCHER ELECTRIC LIGHT AND POWER COMPANY (LIMITED).—The return of this company, made up to the 13th inst., was registered 20th inst. The nominal capital is £300,000 in £5 shares. 27,937 shares have been taken up, and 16,576 shares have been issued as fully paid. A call of £1 has been made and responded to to the amount of £17,743 5s , which together with £82,880 considered as paid makes the paid-up capital £100,623 5s. The total amount of the calls unpaid is £10,193 15s.

RIVER PLATE TELEPHONE AND ELECTRIC LIGHT COMPANY (LIMITED).—The return of this company, made up to May 31st, was filed July 27th. The nominal capital is £100,000, in £5 shares. 3,290 shares have been taken up and £3 per share called thereupon. The total amount of calls paid is £9,870.

ELECTRICAL TRADING COMPANY (LIMITED).—The return of this company, made up to June 14th, was filed on June 17th. The nominal capital is £10,000, divided into 500 ordinary and 500 deferred shares of £10 each. 170 ordinary and 500 deferred shares have been taken up, and upon the former £5 has been called and the full amount upon the latter. The calls paid upon the ordinary shares amount to £717 10s. and upon the deferred shares £5,000, leaving £132 10s. unpaid.

INSULITE COMPANY (LIMITED).—The return of this company, made up to June 23rd, was filed July 3rd. The nominal capital is £20,000 in £10 shares. 1,000 shares have been allotted, 500 of which were issued as fully paid. A call of £10 has been made and responded to, and, including amount considered as paid up, the total amount of calls paid is £10,000.

NEW PATENTS—1882.

4484. "Manufacture of resistances for electrical purposes." J. H. JOHNSON. (Communicated by P. Uzell.) Dated September 20.

4490. "Secondary or accumulator voltaic batteries." A. KHOTINSKY. Dated September 20.

4492. "Improvements in apparatus for producing and regulating electric currents, for the production of the electric light, and in the lamps, fittings, and apparatus employed therewith, part of such apparatus being applicable to other purposes." A. R. SENNETT. Dated September 20.

4503. "Apparatus for governing electric currents." J. S. BEEMAN, W. TAYLOR, and F. KING. Dated September 21.

4504. "New or improved apparatus for measuring electric force and currents." J. S. BEEMAN, W. TAYLOR, and F. KING. Dated September 21.

4511. "Apparatus for storing, measuring, and regulating electricity." J. D. F. ANDREWS. Dated September 21.

4512. "Portable voltaic batteries." J. MACKENZIE. Dated September 21.

4525. "Manufacture of secondary batteries or accumulators." J. MAXWELL LYTE. Dated September 22.

4527. "Electro-magnetic engraving machines." B. J. CARTER. (Communicated by G. McK. Guerrant.) Dated September 22.

4532. "Improvements in regulating currents from voltaic cells and to and from secondary batteries when being charged and discharged, and in apparatus connected therewith." W. E. AYRTON and J. PERRY. Dated September 23.

4535. "Dynamo-electric machines." F. C. GLASER. (Communicated by C. Zipernowsky and M. Deri.) Dated September 23.

4543. "Improved means of producing electric currents for lighting and general purposes." F. SWIFT and A. J. M. READE. Dated September 23.

4547. "Dynamo-electric machines." R. BARKER. Dated September 23.

4548. "Improvements relating to mechanism for transporting goods and passengers by the aid of electricity, and the regulation of the speed of machinery driven by electricity." F. JENKIN. Dated September 23.

4555. "Dynamo-electric engines." A. LALANX and M. BAUER. Dated September 25.

4561. "Secondary batteries or electric accumulators." F. C. HILLS. Dated September 25.

4567. "Means or apparatus for obtaining mechanical effect by electrical energy." E. L. VOICE. Dated September 26.

4573. "Portable electrical apparatus for lighting gas flames." J. IMRAY. (Communicated by E. Arnold.) Dated September 26.

4580. "Decomposing alloys by electrolysis and dialysis, which invention is also applicable for electrotyping and other purposes." W. R. LAKE. (Communicated by H. R. Cassel.) Dated September 26.

4596. "Measuring and regulating electric currents." S. Z. de FERRANTI and A. THOMPSON. Dated September 27.

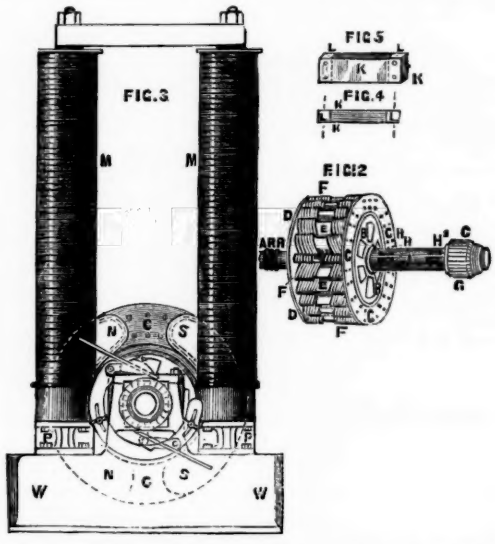
4599. "Construction of secondary or storage batteries, and preparation of the spongy lead to be used therein." W. CLARK. (Communicated by N. de Kabath.) Dated September 27.

ABSTRACTS OF PUBLISHED SPECIFICATIONS. 1882.

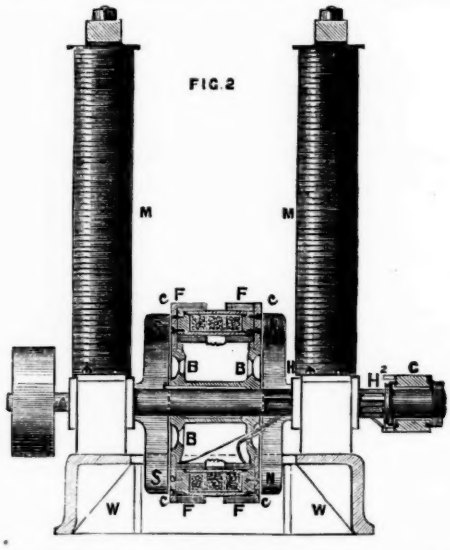
329. "Telephone transmitters." SILVANUS PHILLIPS THOMPSON. Dated January 23. 2d. Relates to the employment of substances other than carbon in the instruments known as telephone transmitters, for which purpose it is proposed to employ the sulphide molybdenum or the sulphides of the following metals, viz.: lead, silver, antimony, bismuth, iron, nickel, cobalt, zinc, aluminium, manganese, mercury, thallium, or any other metallic sulphide or compound of the said sulphides, except only the sulphide of copper, and also the selenides, arsenides, phosphides, and antimonides of the said metals, or any of them, not excepting copper, also the oxides of iron, copper, and other metals, or the hydrates of the said oxides, except peroxide of lead. These substances, or any of them, it is proposed to apply, whether prepared artificially or existing as a native ore, either in masses, or in fragments, or in powder, to vary the resistance of a telephonic circuit, as carbon is applied in the carbon transmitters, by interposing them in the circuit of the current between appropriate conductors of platinum or other material. (*Provisional protection not allowed.*)

333. "Electric cables." T. J. HANDFORD. (A communication from abroad by P. B. Delaney, of America.) Dated January 23. 6d. Relates to that class of electric cables in which provision is made for obviating the effects of induction by the wires upon each other. The object of this invention is to interpose a continuous conductor into the meshes between the wires of a plaited or braided cable and thus eliminate from this class of cables the last vestige of induction.

756. "Machines for producing electric currents." J. BROCKIE. Dated February 16. 6d. Relates to the construction of the revolving armature. Fig. 1 shows in perspective the improved revolving armature, and consists of the main shaft, A, upon which the non-magnetic boss, B, is keyed—carrying the two iron rings, C and D. The cross-bars or magnets, E E E, are shown occupying the space between these iron rings, and to which they are securely fastened. The coils, F F F, are wound on the extremities of the transverse bars, and the ends of the respective coils are led to the contact pieces, G G, forming the commutator. The shaft is preferably made hollow at the larger end, as shown, and the wires are led through the slots, H H H, into the interior of the shaft, whence they emerge by the other slots, H^2 H^3, and then to the contact pieces. The joining up of the several coils may be done in various ways. 1st, The free ends of each pair of coils may be led to contact segments on exactly opposite sides of the commutator; in this case twice as many contact pieces as there are cross-bars or magnets are required, and the currents in each coil are commutated separately, and they will be cut out of circuit during the revolution of the armature, except at those times when the rubbers or brushes make contact with the particular segments belonging to the coils. 2nd, Two or more cross-magnets could be joined up in series or in parallel circuit, and the two free ends of this system led



to contact pieces on opposite sides of the commutator. 3rd, The coils may be joined continuously, forming a complete circuit, and in this case any convenient number of wires may be arranged at equal distances making electrical contact with this circuit and led to each segment of the commutator in regular order. 4th, The coils may be joined up in pairs diametrically opposite each other. Figs. 2 and 3 show a complete machine constructed with the aforesaid armature. The pole-pieces, N N and S S, of the field or exciting magnets are bolted to brass or non-magnetic blocks, P P P P, which latter are in turn bolted to the foundation-plate, W. The faces of the pole-pieces are accurately planed or turned, and the revolving armature is also turned on the outside iron faces, so that a very small space intervenes



between the field-magnet, M, and the armature. Rings, R R R, are turned on the shaft, at the driving-end (fig. 1), and work in a thrust-block bearing to prevent end play. The inventor sometimes winds the middle part of the cross-bar magnets, E E E, and uses the current so produced to excite the field-magnets, in which case an additional commutator is required. The bar-magnets are constructed in layers, as shown in plan at fig. 4 and in side view at fig. 5, where two side-plates, K K, are riveted to the end-blocks, L L, and a space is so formed which is filled up with several sheets of iron all riveted together, as shown, or filled with iron wire or iron filings, as shown in fig. 2, in which latter case a covering will be required to keep the

filings in position. The iron rings, C and D, are sometimes made with a deep groove cut in their peripheries, and these grooves are then filled up with soft iron wire or hoop iron for the purpose of reducing the tendency to heat and obtaining a better magnetic heat.

760. "Dynamo-electric and electro-dynamic machines." C. W. SIEMENS. Dated February 16. 6d. Relates to a construction and arrangement of a machine which can be used as a dynamo-electric machine for converting motive power into electricity, or as an electro-dynamic machine for converting electricity into motive power. A peculiar feature of the machine is that the same coils of insulated wire serve both for the induction of electrical currents and also for induction of magnetism. Fig 1 is an end view, and Fig 2 is

FIG 1

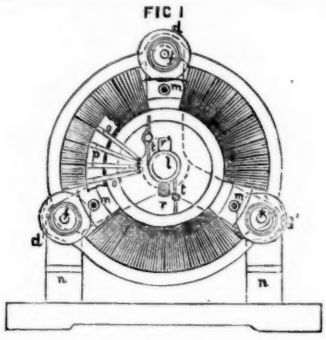
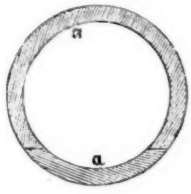
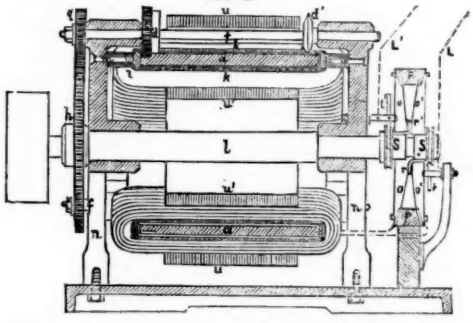


FIG 3



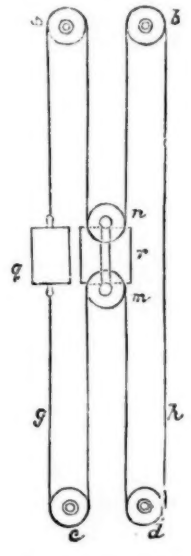
a longitudinal section of a machine according to this invention, fig. 3 is a transverse section of the iron cylinder which operates in the machine as a magnet. Two end frames, *n n*, fixed on a base, have bearings for a central shaft, *l*, and also for three shafts, *f*. Three bolts or screws, *m*, surrounded by short pieces of tubes secure to the frames, *n*, two rings, *i*, *i*, of non-conducting material, such as ebonite. To these rings are fixed an outer cylindrical shell, *k*, of sheet brass or other non-magnetic metal, and a similar inner shell, k^1, these two shells and the end rings to which they are fixed forming together a hollow annular casing, within which revolves the cylindrical magnet, *a*. This magnet, as shown in fig. 3, consists of a plate of iron bent round in cylindrical form, leaving about one-fourth of the circumference open, and this arc is filled in with a segment, a^1, of brass or other non-magnetic metal fixed to the iron and completing the hollow cylinder. Instead of bending the iron, *a*, in one piece, it

FIG 2



may consist of several thicknesses or of several lengths joined end to end. The hollow cylinder thus formed is of such size as nearly to fit, but to revolve freely within the casing enclosed by the shells, $k\,k^1$, and the end rings, *i*. It is maintained in position within the casing by three rollers, *d*, on the shafts, *f*, bearing against its periphery near one end, and other three rollers, d^1, on the same shafts, *f*, bearing against its periphery near its other end. To prevent end movement of the cylinder the rollers, d^1, are V-shaped and enter a V-groove in the cylinder. The cylinder is caused to revolve uniformly with the central shaft, *l*, in the following manner. On the shaft, *l*, is fixed a toothed wheel, *h*, which gears with pinions, *q*, on the shafts, *f*, and pinions, *e*, on these shafts gear with teeth formed at one end of the cylinder, *a*. The edges of the rollers, $d\,d^1$, and of the pinions, *e*, pass through slits in the outer shell, *k*. Around the shells, $k\,k^1$, are wound lengthwise a number of coils of insulated wire. A convenient number of such coils, as shown in fig 1, is 18, being 6 coils in each of the three divisions of the circumference, between the three blank spaces left for the rollers, $d\,d^1$, pinions, *e*, and screws, *m*, that fix the annular casing on which the coils are wound. The number of coils might be varied, but for the following explanation I will assume 18 to be the number as shown. The wire of each of the coils has two ends, consequently there are 36 wires connected in the following manner. A ring, *p*, of non-conducting material has fixed on each of sloping sides 18 springs, *o*, on the one side, and o^1, on the other. These springs may extend inwards radially, but it is preferred to incline them, as shown in fig. 1, forwards in the direction of rotation of the shaft, *l*. The springs, *o*, on the one side of the ring, *p*, and the springs, o^1, on the other side of *p*, incline towards each other, so that each spring, *o*, meets a spring, o^1, and the meetings of all the 18 pairs of springs is in a plane perpendicular to the axis of the machine. One end of the wire of each coil is connected to one of the springs, *o*, and the other end of the same wire is connected to one of the springs, o^1, not to that which meets the former, but to the spring next in order, so that the outgoing end of each coil becomes connected through the meeting of a pair of springs, *o* and o^1, with the ingoing end of the coil next in order, and if all the 18 springs, *o*, were simultaneously in contact with the 18 springs, o^1, there would be a closed circuit including all the 18 coils following in order. On the shaft, *l*, there are fixed two knives or separators, *r* and r^1, which as the shaft revolves pass between the pairs of springs, *o* and o^1, separating each pair successively. The knife, *r*, has on one side a metal face, and on the other side a face of non-conducting material such as ivory, and the spring, r^1, has a like facing on the side opposite to that of *r*, so that while the knife, *r*, is separating a pair of the springs, it makes electrical contact only with one of those marked *o*, and while the knife, r^1, separates a pair of springs it makes contact with one of those marked o^1. The knife, *r*, is connected to a ring, *s*, fixed insulated on the shaft, *l*, and the knife, r^1, is connected to a similar ring, s^1, and against these rings respectively rub brushes, *t* and t^1, which make connection to the wires, L L^1, of the external circuit. When the machine is employed dynamo-electrically by causing the shaft, *l*, to rotate, the action is as follows:—The iron cylinder, *a*, having certain residuary magnetism, in revolving through the coils induces in them electrical currents, and the currents so induced react on the cylinder increasing its magnetism until the machine reaches the limit of its power. The circuit of the coils being broken at successive points by the knives, *r*, r^1, separating the successive springs through the contact of which, if maintained, that circuit would be closed, the currents induced in the coils are directed by the knives, *r*, r^1, the rings, *s*, s^1, and the brushes, *t*, t^1, into the external circuit, L, L^1. Conversely when electricity is transmitted to the machine by the line-wires, L, L^1, currents are by the action of the knives, *r*, r^1, passed successively through the coils so as to cause the cylinder, *a*, to rotate and drive the shaft, *l*, the machine then operating as an electro-dynamic machine. The power of the machine for either use may be increased by an external shell, *u*, of iron encircling all the coils, and by an internal shell, u^1, of iron inside the coils. These shells, or either of them, may consist of convolutions of iron wire. It is sometimes desirable to make the machine reversible, so that the shaft may revolve in either direction. In that case each of the knives, *r*, r^1, instead of having one side of non-conducting material may have both sides metal separated by insulating material between them, and two additional rings, such as *s*, s^1, are provided with their brushes, one side of each knife being connected to a ring corresponding with *s* and the other side to a ring corresponding with s^1. By connecting one pair of the brushes, *t*, t^1, to the external circuit the machine is set to revolve in the one direction; but by disconnecting these brushes from the circuit and connecting the other pair to it, the machine is set for revolution in the opposite direction.

831. "Electric lamps, &c." J. RAPIEFF. Dated February 21. 6d. For the purpose of forming the arc for the production of light in an electric lamp between the points of carbon, and for feeding the carbons together as they burn away the inventor connects by any suitable means or appliances one or both carbon-holders to one movable axle, piston, or equivalent mechanism, in such a way that the movement of this mechanism in one direction shall bring the carbons together and the movement in the other direction shall separate them; this axle is operated by means of one or more weights or



springs or other source of power, in connection by suitable mechanical means with the above-named axle or its equivalent, in such a way that by acting through the medium of suitable electrical or electro-magnetic appliances there can be effected the rotation of this axle, or the movement of its equivalent, in either direction by opening or closing one of the two distinct parts of this mechanical connection. In the figure, *q* shows the weight and *r* another smaller weight—*a b c d* are pulleys on shafts fixed to a suitable frame—*n* and *m* are also pulleys attached to the weight, *r*, an endless cord or chain, *g h*, passes round these pulleys in such a way that it cannot ship round the pulleys, *a* or *b*, without revolving them, the weight, *q*, is attached to this cord by means of a clutch in such a way that it can be easily raised by hand during the time of charging the lamp. For the same purpose the pulleys, *a* and *b*, are provided with ratchet wheels

and pawls. The pulleys, *a* and *b*, are also provided either directly or by means of a train of wheels or other suitable means with a break or escapement actuated by an electro-magnetic appliance whereby the rotation is checked or impeded. So long as the pulleys, *a b*, are held stationary both weights remain suspended. By releasing the pulley, *b*, the weight, *r*, is allowed to descend. But so soon as the pulley, *b*, is checked and the pulley, *a*, released the weight, *q*, will descend, at the same time raising the weight, *r*. Now, if this weight, *r*, is connected directly or by suitable mechanical means with one or both of the carbons of the electric lamp it is easily understood that in the one case the carbons will be brought together and in the other case separated. To insure proper action of the mechanism the endless chain or cord should be tightened, and for this purpose the shafts of one or more pulleys, for instance, *c* or *d*, or both are fixed in the movable frame or fork which is tightened by means of a spring or springs, the tension of which is regulated by one or more set screws.

CITY NOTES, REPORTS, MEETINGS, &c.

THE AUSTRALASIAN ELECTRIC LIGHT, POWER, AND STORAGE COMPANY (LIMITED).

On Thursday an extraordinary general meeting of the shareholders of this company was held at the offices of the company, 4, Copthall Buildings, Mr. R. Want, Chairman of the company, presiding, to consider, and if approved, to confirm the following resolutions, which were passed at an extraordinary general meeting, held on the 11th instant, that is to say:—"1. That the 69th of the articles of association of the company be amended by striking out the following words at the commencement thereof—namely, 'notwithstanding any rule of law or equity to the contrary.' 2. That the 71st of the articles of association of the company be amended by altering the figures '1885' occuring therein to '1884,' and altering the figures '1886' occuring therein to '1885.'"

The notice convening the meeting having been read by the secretary, Mr. J. H. Duncan,

The Chairman said: Gentlemen, you have heard the notice read for which this meeting is called. I need only repeat that the object of it is to consider, and if approved, to confirm the resolutions passed at a recent extraordinary general meeting on the 11th instant. These having been read, I do not think I need refer to them again, which were simply revisions made by the Stock Exchange Committee to meet their requirements.

Mr. Jackman remarked that he thought no reason was assigned by the secretary on the previous occasion for the alterations. He did not know it was so.

The Chairman said it was mentioned in the notice of the 11th August that they were in order to get a quotation and a settlement. The chairman then put the proposition, which was carried unanimously, and the business of the meeting ended.

Mr. Jackman inquired who Mr. "W. W. Duncan" was. That gentleman had taken upon himself to write upon the company.

The Chairman: I think he favours our company.

Mr. Jackman thought that gentleman should remember the terse proverb about proffered service. He need not say the rest. He was very sorry to receive it himself.

The Chairman remarked that the board had not the slightest knowledge of the writer.

Mr. Jackman asked if the board had received any satisfactory news from their agents.

The Chairman said the board had received nothing particularly new since the previous meeting. They had a number of letters, received last night, which they were about to examine that day.

THE ANGLO-AMERICAN TELEGRAPH COMPANY.—At a meeting of the Board of Directors it was resolved, after placing £37,500 to the renewal fund, to declare an interim dividend for the quarter ending September 30th of 15s. per cent. on the ordinary stock and 30s. per cent. on the preferred stock, both free of income-tax, payable on November 1st to the stockholders registered on the books of the company on October 7th.

THE EASTERN TELEGRAPH COMPANY (LIMITED) announce the payment on the 13th of October next of a dividend of 3s. per share on the 6 per cent. preference shares of the company, less income-tax, for the quarter ended September 30th, 1882; and that an interim dividend of 2s. 6d. per share on the ordinary shares of the company, free of income-tax, will be paid on the same date.

TELEGRAMS FOR THE WEST INDIES.—The cable between St. Vincent and Grenada is interrupted; and as the cable between St. Thomas and St. Kitts is not yet repaired, there is at present no telegraphic communication with the islands of St. Kitts, Antigua, Guadaloupe, Dominica, Martinique, St. Lucia, St. Vincent, and Barbadoes. The Post-office gives notice that telegrams addressed to the above places will be subject to delay.

THE WESTERN UNION TELEGRAPH COMPANY.—The directors of the Western Union Telegraph Company have declared a quarterly dividend of 1½ per cent. The report submitted was favourable and showed a surplus, after allowing for the payment of the dividend declared, of 2,587,620 dols., against 1,666,240 dols. on July 1st.

THE CABLE-LAYING STEAMER *Scotia*.—After an absence of three weeks, the cable-laying steamer *Scotia*, Captain Cato, has returned to Plymouth, having successfully completed the repair of the cable of the Anglo-American Company from Brest to New York. It will be recollected that this vessel entered upon her task in May last. The break in the cable having been discovered, the position being 1,000 miles from the Channel, the cable was taken up and joined, and the *Scotia* left mid-ocean to make good the cable 400 miles from Brest, a "fault" having been ascertained to exist. While engaged in the second operation it was found that communication could not be had with America. Tests proved that the cable had parted where it had been joined. The *Scotia* came into Plymouth, replenished her bunkers, and again left. Having repaired the cable off Brest, the vessel proceeded to the position of the breakage, which was but twenty miles eastward of the spot where the cable had first given way. Great difficulties were encountered in taking up the wire and buoying it. It lay on a deep and uneven bottom, and time after time, after it had been buoyed, the buoys were carried away. When a little more than a month since the *Scotia* left the Atlantic for Plymouth the eastern end was buoyed. On her return, however, the buoy had disappeared. No further mishaps were encountered. The cable was completed, messages were passed through, and the *Scotia* was ordered to Plymouth.—*The Times*.

LATEST QUOTATIONS.

Authorised Issue.	Shares.	Name.	Paid.	Closing Quotations. Sept. 27.	Business Done.
		ELECTRIC LIGHT.			
40,000	10	Anglo-American Brush Co.	4	12½-12¾	12½-¾.13.12½
		Do. Do.	10	24 - 28	26½
30,000	5	Australasian Electric Light, Power & Storage Co.	3	..	
24,900	10	British Insulite Co., Limited, "A" Shares	5	4½- 5	
30,000	5	Brush Electric Light & Power Co. (Scotland)	2½	1 - 1⅛	1⅛
25,000	5	Great Western Electric Light & Power Co.	2½	¾- 1¼	
24,980	5	Hammond Electric Light & Power Supply Co.	2½	8¼- 8⅝	8⅞-¾-⅝-⅞-⅝
40,000	5	Indian & Oriental Electrical Storage Works Co.	2	1½- 2	
172,500	1	Maxim-Weston Electric Light and Power Co.	1	⅝- ¾	11-16
40,000	5	Pilsen, Joel & General Electric Light Co.	2	1¾- 2¼	
..	..	South African Brush Electric Light & Power Co.	2½	½- 1	
100,000	5	Swan United Electric Light Co., Limited	2	2 - 2¼	
		TELEGRAPHS.			
2,116,400*l.*	Stk.	Anglo-American, Limited	100	50½- 51½	50*.1½
2,441,800*l.*	Stk.	Do. Preferred (Def'd. receiving no div. until)	100	82½ 83½	82⅞-½-⅝.3
2,441,800*l.*	Stk.	Do. Deferred (6 p. c. has been paid to Pref.)	100	19 - 20	20½
130,000	10	Brazilian Submarine, Limited	10	11½- 12½	
16,000	10	Cuba, Limited	10	9¾- 10¼	
6,000	10	Do. 10 per cent. Preference	10	16 - 17	
13,000	10	Direct Spanish, Limited	9	6¼- 6⅝	
6,000	10	Do. 10 per cent. Preference	10	15½- 16½	11-16
65,000	20	Direct United States Cable, Limited, 1877	20	11½- 12	11-16
100,000*l.*	100	Do. 6 per cent. Debenture, repayable 1884	100	101 -104	10⅜-⅛.11.10⅞
380,000	10	Eastern, Limited	10	10⅝- 11	
70,000	10	Do. 6 per cent. Preference	10	13 - 13½	
232,000*l.*	100	Do. 6 do. Debentures, repayable Oct. 1883	100	100 -105	
200,000*l.*	100	Do. 5 do. do. Aug. 1887	100	101 -105	
200,000*l.*	100	Do. 5 do. do. Aug. 1899	100	100 -105	
199,750	19	Eastern Extension, Australasia & China, Limited	10	11⅜- 11½	
320,000	100	Do. 6 p. c. Debentures, repayable Feb. 1891	100	105 -110	
500,000	100	Do. 5 p. c. (Australian Gov. Subsidy) Deb. 1900	100	102 -105	
140,000	100	Do. do. registered, repayable 1900	100	102 -105	
100,000*l.*	100	Do. 5 per cent. Debenture, 1890	100	102 -105	
254,300*l.*	100	(Eastern and South African Limited 5 per cent.) (Mort. Deb. Registered redeemable 1 Jan. 1900)	100	101 -104	
345,700*l.*	100	Do. do. do. To Bearer	100	101 -104	
22,050	10	German Union Telegraph and Trust, Limited	10	9¾- 10¼	
163,390	10	Globe Telegraph and Trust, Limited	10	6⅜- 6¾	
163,209	10	Do. 6 per cent. Preference	10	12⅝- 12¾	
125,000	10	Great Northern	10	12¾- 12¾	12¾
100,000*l.*	100	Do. 5 per cent. Debentures	100	100 -103	
31,200	10	India-Rubber, Gutta-Percha and Telegraph Works	10	26½- 27½	27½
100,000	100	Do. 6 per cent. Debentures, 1886	100	100 -103	
17,000	25	Indo-European, Limited	25	29½- 30½	
38,148	10	London Platino-Brazilian, Limited	10	4½- 5	
12,000	10	Mediterranean Extension, Limited	10	1½- 2¼	
8,200	10	Do. 8 per cent. Preference	10	8 - 9	
9,000	8	Reuter's, Limited	8	12¾- 13½	
280,000	Stk.	Submarine	100	255 -265	
58,225	1	Do. Scrip	1	2⅜- 2⅝	
4,200	Cert.	Submarine Cables Trust	100	102 -107	
37,350	12	Telegraph Construction and Maintenance	12	30 - 31	
150,000	100	Do. 6 per cent. Bonds, 1884	100	102 -104	
186,750	5	Do. 2nd Bonus Trust Cert.	5	1½- 1¾	
30,000	10	West Coast of America, Limited	10	4½- 5	
150,000	100	Do. 8 per cent. Debentures	..	.. ..	
69,910	20	Western and Brazilian, Limited	20	6¾- 7⅛	
200,000*l.*	100	Do. 6 per cent. Debentures "A" 1910	100	104 -107	
2,500	100	Do. 6 p.c. Mort. Deb. series B of '80. red. Feb., 1910	100	97 -100	
1,500	$1,000	Western Union of U. S. 7 p.c.1 Mort.(Building) Bds.	$1,000	123 -128	
1,030,000*l.*	100	Do. 6 per cent. Sterling Bonds	100	100 -103	
88,321	10	West India and Panama, Limited	10	1⅜- 1⅝	1½
34,563	10	Do. 6 per cent. 1st Preference	10	8¼- 9	
4,669	10	Do. 6 do. 2nd do.	10	7½- 7¾	
		TELEPHONES.			
154,165	1	Con. Telephone & Maintenance, Ld. Nos. 1 to 154,165	1	1½- 1¾	
200,000	1	Oriental Telephone Co., Nos. 100,000 to 300,000	½	¾- 1	1.01-32
100,000	5	United Telephone Co.	5	10¼- 10⅞	

* Exceptional amount at special price.

TRAFFIC RECEIPTS.

The West Coast of America Telegraph Company (Limited). Gross earnings, Traffics and Steamer, month ending July 31st, 1882, £3,475, against £3,120 in the corresponding period of last year. Month ending August 31st, 1882, £3,400, against £3,185 in the corresponding period of last year.

West India and Panama Telegraph Company (Limited). The estimated traffic receipts for the half-month ended the 15th September are £1,647, as compared with £1,692 in the corresponding period of 1881. The June receipts, estimated at £5,089, realised £5,131.

The Western and Brazilian Telegraph Company (Limited). The traffic receipts for the week ending 8th September, 1882, were £2,175; and for the week ending September 15th, 1882, were £2,161; and for the week ending 22nd September, 1882, were £2,309, after deducting the "fifth" of the gross receipts payable to the London Platino-Brazilian Telegraph Company (Limited)